

FINAL
INSURANCE PROJECT
PLAN (QAPP)

ROKEE COUNTY
NA SUBSITE

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icer, EPA Region VII



July 24, 1985

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Ms. Alice Fuerst
RSPO, Cherokee County Site
Environmental Protection Agency
324 E. 11th Street, Room 1507
Kansas City, Missouri 64106

Dear Ms. Fuerst:

Enclosed are six (6) copies of the Final QAPP for the Cherokee County Site, Galena Subsite. We would appreciate Region VII approval of this document by July 31 so we can begin field sampling on August 5.

The QAPP includes two appendices that provide the detail of our planned field operations and sampling; namely Appendix A, the Field Operations Plan, and Appendix B, the Standard Operating Procedures.

As per our discussions concerning the air quality program, you will note that a few sections in the Field Operations Plan and Standard Operating Procedures have been left blank. These sections were left blank because we are revising the sampling specifics to incorporate an X-Ray Fluorescence technique which, we believe, is a better approach for our investigations than the X-Ray Diffraction in the Draft QAPP.

We are requesting approval of all but the air quality program at this time, and we will send the air quality sections next week. Please call if you have any questions.

Sincerely,

A handwritten signature in cursive script, reading "Richard Moos".

Richard E. Moos, Ph.D.
SPM, Cherokee County Site

DE/4C/037/tg
Enclosures

| <u>Final QAPP Distribution</u> | <u>Copy No.</u> |
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DE/CC/154

PREFACE

Environmental Protection Agency (EPA) policy requires all Remedial Investigation/Feasibility Study (RI/FS) activities to be under the control of a centrally managed quality assurance (QA) program. This requirement applies to all environmental monitoring and measurement efforts mandated or supported by EPA.

Each contractor generating data has the responsibility to implement procedures that assure that the precision, accuracy, completeness, representativeness, and comparability of their data are known and documented. CH2M HILL has specified target levels of quality that the data should meet in order to be compatible with the project objectives. This Quality Assurance Project Plan (QAPP) has been prepared to ensure that this responsibility is met uniformly throughout the duration of the Phase I RI.

This QAPP presents, in specific terms, the policies, organization, objectives, functional activities, and specific QA and quality control (QC) activities designed to achieve the data quality goals of the Cherokee County-Galena Subsite Phase I RI work. The scope, schedule, and budget for the Phase I RI work are described in the Work Plan (EPA, 1985b). The work plan was based on the National Oil and Hazardous Substance Contingency Plan (NCP) promulgated by the EPA on July 16, 1982 (47 FR 31180-31243).

This QAPP represents the first level of quality assurance/quality control (QA/QC) detail for the Phase I RI work. Further detail and refinement are to be provided in the Field Operations Plan (FOP, Appendix A of this QAPP) and the Laboratory Analytical Protocol (LAP). The FOP and LAP include EPA approved methods and procedures where applicable. The FOP and LAP are consistent with established EPA QA/QC programs (in particular the EPA's Contract Laboratory Program) and the current standards of practice for the Superfund program.

CONTENTS

| | <u>Page</u> |
|---|-------------|
| Preface | ii |
| 1.0 Project Name | 1 |
| 2.0 Project Requested By | 1 |
| 3.0 Date of Request | 1 |
| 4.0 Date of Project Initiation | 1 |
| 5.0 Project Officer | 1 |
| 6.0 Quality Assurance Officer | 1 |
| 7.0 Project Description | 2 |
| 8.0 Fiscal Information | 14 |
| 9.0 Schedule of Tasks and Products | 15 |
| 10.0 Project Organization and Responsibility | 17 |
| 11.0 Data Quality Requirements and Assessments | 20 |
| 12.0 Sampling Procedures and Field Measurements | 25 |
| 13.0 Sample Custody and Documentation | 26 |
| 14.0 Calibration Procedures and Preventive Maintenance | 27 |
| 15.0 Analytical Procedures | 28 |
| 16.0 Data Validation | 29 |
| 17.0 Performance and Systems Audits | 32 |
| 18.0 Corrective Action Procedures | 33 |
| 19.0 Reports | 34 |
| References | 35 |
| Appendix A--Field Operations Plan | A-1 |
| Appendix B--Standard Operating Procedures | B-1 |
| Appendix C--Data Reduction and Validation Methods | C-1 |
| Appendix D--Audit Program | D-1 |
| Appendix E--Site Health and Safety Plan | E-1 |
| FIGURES | |
| 7-1 Site Location, Cherokee County Site, Kansas | 3 |
| 9-1 Remedial Investigation Schedule | 16 |
| 10-1 Project Organization | 19 |
| TABLES | |
| 7-1 Summary of Phase I Sampling | 10 |
| 10-1 Contact Information for Key Personnel | 19 |
| 11-1 QA/QC Samples | 23 |

DE/CC/149

- 1.0 PROJECT NAME: Cherokee County, Galena Subsite,
Remedial Investigation
- 2.0 PROJECT REQUESTED BY: EPA Region VII
Work Assignment No. 127.7LB9.0
- 3.0 DATE OF REQUEST: Work Assignment from EPA Head-
quarters on August 8, 1984,
and approval of the First
Interim Work assignment by EPA
Region VII on October 2, 1984
- 4.0 DATE OF PROJECT INITIATION: August 15, 1984
- 5.0 PROJECT OFFICER: Alice Fuerst, EPA Region VII
- 6.0 QUALITY ASSURANCE OFFICER: Charles Hensley, EPA
Region VII

7.0 PROJECT DESCRIPTION

7.1 BACKGROUND

The Cherokee County site is a triangular-shaped area in the very southeast corner of the state of Kansas, including the communities of Treece, Baxter Springs, and Galena (see Figure 7-1). Portions of Cherokee County, Kansas, Ottawa County, Oklahoma, and Jasper County, Missouri, comprise what is known as the Tri-State Mining District. Earlier in the century, the district had one of the richest lead-zinc ore deposits in the world. The entire Tri-State mining area encompasses about 500 square miles; the general Cherokee County site area includes approximately 60 square miles.

Potential environmental hazards at the Cherokee County site are associated with a variety of site conditions. Underground mining operations in the area ranged from depths of approximately 50 feet to almost 400 feet. The area is essentially honeycombed with mines. Water was continually pumped out of these mines during production. When mining activity and pumping from the mines ceased, the mines began filling with water through natural groundwater recharge and direct inflow of surface runoff via mine shafts, test holes, and subsidence areas. The water which filled the abandoned mine shafts and drill holes reacted with the reduced sulfide compounds in the rocks to form acid mine water. The acidic mine water, in turn, dissolved metals and salts in the geologic strata. As a result, highly mineralized, low pH water has subsequently surfaced, and surface streams in the area as well as a groundwater aquifer have experienced degradation in their quality (EPA, 1984a and 1985a).

The 60 years of mining activity in Cherokee County has also resulted in a significant generation of milling and tailings wastes. The majority of these wastes were accumulated and stored as large piles, called "chat piles," throughout the area. In the presence of water, oxidation of iron sulfides (pyrite and marcasite) which are present in the tailings can produce an acid which will result in the solubilization of heavy metals. Runoff and/or seepage from the chat piles and from tailings ponds may contain high concentrations of heavy metals which can degrade the water quality of receiving streams.

The chat piles are also suspected of causing degradation of air quality in the area through air entrainment of particulates containing heavy metals. A epidemiological study by a professor at the University of Kansas Medical Center

SECTION NO. 7
 REVISION NO. 1
 DATE: 7/23/85
 PAGE 3 OF 35

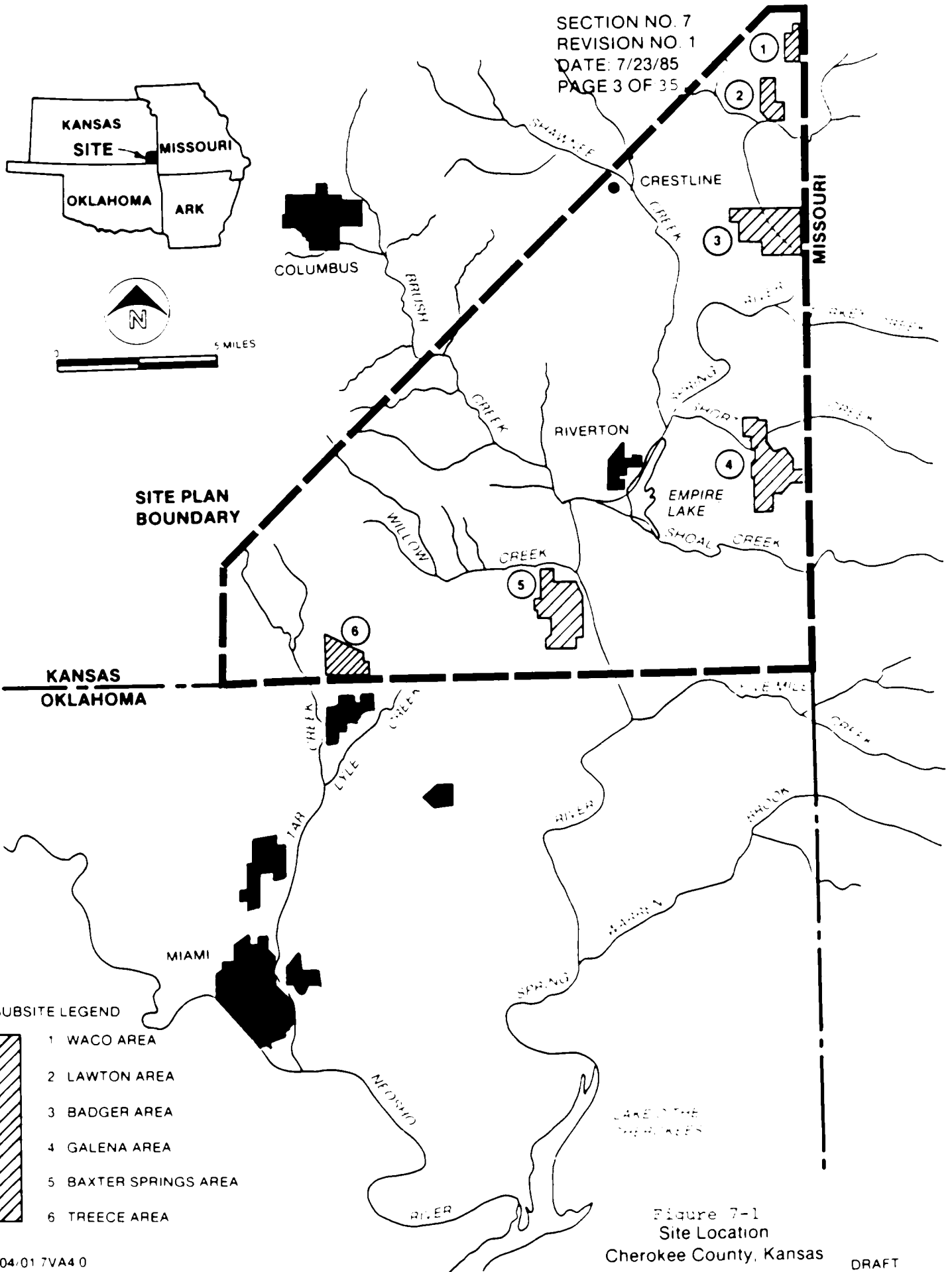
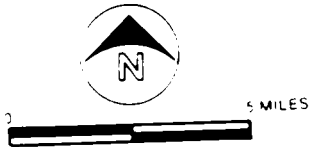
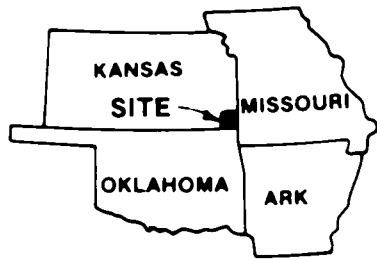


Figure 7-1
 Site Location
 Cherokee County, Kansas

DRAFT

indicated a higher incidence of lung cancer in the Tri-State Area (Neuberger, 1981; Neuberger and Hollowell, 1982). It was hypothesized that the incidence of lung cancer might be correlated with the air quality of the area, although no data has been presented to support that hypothesis.

Because of the large size of the Cherokee County site, it has been divided into six subsites, based primarily on the presence of physical surface effects of abandoned mining. These subsites have been designated as areas near Badger, Baxter Springs, Galena, Lawton, Treece, and Waco (Figure 7-1). The EPA has directed initial work plan development and RI activities to focus on the Galena subsite. This QAPP is concerned only with the Galena subsite, an approximately 9-square-mile area in the east-central portion of the Cherokee County site (Figure 7-1).

The available scientific literature and data relative to the Cherokee County Site were compiled and reviewed in late 1984a (EPA, 1984a), and in the spring of 1985 the existing data base specific to the Galena subsite was used to characterize the Galena portion of the Cherokee County site (EPA, 1985a). The characterization was performed to:

- o Assess whether potential environmental or human health hazards associated with abandoned mining activity in the Galena area are supported by the existing data base.
- o Identify the additional sampling, if any, required to fill data gaps.

The data evaluation indicated that little quantitative data on surface water or groundwater quality in Galena are available at this time. Trace levels of heavy metals have been detected in the nearby Spring River. The major tributaries to the Spring River, except for Shoal Creek, have high concentrations of sulfate and heavy metals. Short Creek has high concentration of zinc, manganese, cadmium and sulfates. No continuous mine water discharges into surface waters have been identified in Cherokee County, although such discharges may occur on an occasional basis.

Water from the shallow aquifer (Warsaw, Burlington-Keokuk and Fern Glen Limestones), which contains the mine workings in the Cherokee County site, has been found to exceed EPA drinking water standards for sulfate, iron and manganese. Water from the deep aquifer Arbuckle Group (frequently referred to as the Roubidoux Formation), which is below and separated from the shallow aquifer by several hundred feet

of relatively impervious strata, has been generally found to meet drinking water standards.

Information concerning the consumptive use of groundwater and surface water in the area is limited. Other information needed to assess the extent and degree of contamination and potential endangerment to public health, welfare, and the environment, such as accumulation of heavy metals in sediments and in the aquatic food chain, is also lacking.

Little air quality data for the site has been collected and analyzed to present. The existing air quality data generally show heavy metal levels to be below EPA maximum level standards. In 1971, however, before the mining district's environmental problems were considered a significant issue, concern over cattle illness in the Galena area precipitated air quality monitoring in the area for a two-month period. Testing found that lead levels in airborne particulates were relatively high, but not above the ambient air quality standard. Heavy metals were also found in the soils downwind of the smelter, and concentrations of lead in the blood of long-term residents living close to the smelter were relatively high. At that time, the lead smelter was still operating in the area. The smelter ceased operations circa 1971. Soil samples have not been collected near the old smelter since 1973. It is not known whether elevated levels of the metals still persist.

7.2 PURPOSE AND DESCRIPTION OF PHASE I INVESTIGATIVE ACTIVITIES

The primary objective of the Galena subsite Phase I RI is to close the data gaps identified in the existing data evaluation. These data are needed to determine whether a contamination problem exists and poses a threat to public health. In some areas, for example Short Creek, the existing data indicate that a contamination problem does exist. In these areas, Phase I activities will be aimed at locating the sources of the contaminants. The specific Phase I RI activities that will be undertaken to close these data gaps are briefly described below. These RI activities are described in detail in the FOP and SOP, Appendices A and B of this QAPP.

7.2.1 Water Supply Survey (Task RI 3.1)

Purpose: Identify the size of the population potentially at risk through use of potentially contaminated groundwater; aid in formulating and evaluating remedial measures.

Activities:

- Consult with local, state and county health officials, water supply utilities, the Soil Conservation Service, the State Engineer's Office, and local well drillers to discuss typical water supply and water use considerations for the Galena area.
- Visit individual residences and identify the sources of residential water.
- Collect available data on private well construction and water use from residents using private wells.
- Identify private wells that can be used to monitor groundwater quality.

7.2.2 Hydrogeological Investigation (Task RI 3.2)

Purpose: Provide data on groundwater quality, determine water levels, define groundwater regime, determine sources of groundwater contamination.

Activities:

- Identify groundwater sampling locations based on the water supply survey and existing groundwater information. Sampling points will include accessible existing wells and flooded mine shafts.
- Secure permission from private well owners to sample the selected wells.
- Collect samples from the selected wells and shafts. Deliver samples for laboratory analysis.
- Determine water levels in selected wells and mine shafts.
- Survey the location and elevation of selected wells and mine shafts.

7.2.3 Surface Water Investigation (Task RI 3.3)

Purpose: Evaluate water quality of Short Creek, Shoal Creek, Spring River and Empire Lake. The water quality

parameters of concern are those typically associated with acid mine drainage and mining, milling, and smelting. Surface water will also be checked for potential radioactive contaminants.

Activities:

- Identify sampling locations which should reflect the effects of mining or other sources of contaminants on the surface water regime.
- Collect surface water samples and submit for laboratory analysis.
- Collect surface water samples from six locations to check for possible radioactive contaminants.
- Measure flow in selected streams.

7.2.4 Sediment Investigation (Task RI 3.4)

Purpose: Collect data on the presence or absence of inorganic (metal) contamination in selected stream sediments, and check for potential radioactive contaminants in sediments.

Activities:

- Collect samples of stream sediment for metals analyses from four locations on Spring River or Empire Lake, and from locations on Short and Shoal Creeks just upstream of the Spring River.
- Collect sediment samples from six locations to check for possible radioactive contaminants.
- Submit samples for laboratory analysis.

7.2.5 Soils Investigation (Task RI 3.5)

Purpose: Evaluate whether residual metals contamination remains in native soils located downwind of the abandoned Galena smelter.

Activities:

- Collect composite soil samples from areas downwind of the abandoned smelter at Galena.
- Submit samples for laboratory analysis.

7.2.6 Biological Investigation (Task RI 3.6)

Purpose: Assess the potential for human exposure to contamination associated with consumption of fish from Empire Lake.

Scope:

- Collect samples of edible and forage fish from Empire Lake.
- Fillet edible fish and submit edible portions for laboratory analysis.
- Submit total body samples of forage fish for laboratory analysis.

7.2.7 Air Quality Study (Task RI 3.7)

Purpose: Determine whether contaminants related to mining wastes are being transported as airborne particulates from the abandoned mine areas in the Cherokee County area, and assess the impact of these particulates on air quality in the Galena subsite area.

Activities:

- Identify mine wastes that are potential sources of airborne particulates, based on existing information, aerial photographs, and a field survey.
- Install and operate a meteorological station at a location considered representative of the source areas to be sampled.
- Collect separate composite bulk samples from several potential mining waste sources. Also, collect composite surface material (bulk) samples from the location selected as the upwind background monitoring station, and from two locations within Galena selected as stations for monitoring air quality in populated areas. In addition, bulk samples of sources in the proximity of the air particulate sampling stations that may influence the air sample (such as roads, highways, etc.) will be collected.
- Submit all bulk samples for analysis by x-ray fluorescence (XRF) and selected samples for

analysis by x-ray diffraction (XRD) in an attempt to identify a "fingerprint unique to the source.

- Select sampling locations downwind of potential mining waste sources, at populated areas, and upwind of the Galena subsite area.
- Collect airborne particulate samples for XPF/XRD "fingerprint" determinations, heavy metals analysis, and asbestos analysis.
- Submit the airborne particulate samples for heavy metals analysis, asbestos analysis, and for determining the XRF/XRD "fingerprints." An analysis will also be made, using the fingerprints, to attempt to determine the original sources for the particulates on the filter sample (Source Apportionment).

7.3 DATA USAGE

For several environmental media, the Phase I RI will answer the basic question, "Are contaminants present or not?" The primary use of the data collected in the Phase I RI will be to assess whether the abandoned lead/zinc mining and processing in the Galena subsite have resulted in chemical contamination that threatens public health and the environment.

Ultimately, the data will also be used in evaluating potential remedial actions at the Galena subsite. Information collected in the Phase I RI will be used to support the development and evaluation of remedial technologies.

7.4 SAMPLING NETWORK DESIGN AND RATIONALE

A summary of sampling activities to be conducted during the Phase I RI was presented in Section 7.2. A discussion of specific sampling locations and the rationale used in their selection is presented in the Final Work Plan (EPA, 1985b) and in the FOP (Appendix A of this QAPP).

7.5 SAMPLING PARAMETERS

The type, number, and general location of samples to be collected in each Phase I sampling episode, together with a listing of analytical parameters for each sample type, is presented in Table 7-1, Summary of RI Sampling.

Table 7-1
SUMMARY OF PHASE I SAMPLING

| Sample Information | Work Plan Task Name And Number | | | | | |
|--------------------|-------------------------------------|---|--|--|--|--|
| | Groundwater RI 3.2 | Surface Water RI 3.3 | Soil RI 3.4 | Sediment RI 3.5 | Biological RI 3.6 | Air Quality RI 3.7 ^C |
| Type of Sample | Grab | Grab | Composite | Grab | Edible portions (Skin on fillets) of game fish, whole body samples of forage fish | a) Composite samples of mining wastes and surface material near sampling stations b) Airborne particulate filter samples |
| Sample Locations | To Be Determined in the Field | Short Creek and Tributaries Shoal Creek and Tributary Spring River Empire Lake Subsidence Depressions | Eight locations downwind of old smelter | Short Creek - at mouth - upstream of Fertilizer Plant - at state line Spring River at Short Creek Confluence, Shoal Creek Tributaries, Empire Lake | Empire Lake | a) Surface material samples from about five mine waste sources, one upwind station, and two populated areas b) Near the source areas, an upwind station, and two areas within Galena |
| Number of Samples | 41 | 39 (plus 8 for radioactivity) | 18 | 8 (plus 7 for radioactivity) | 6 | a) 8 to 18 b) 134 |

Table 7-1
(continued)

| <u>Investigation</u> | <u>Groundwater</u> | | <u>Surface Water</u> | | <u>Soil</u> | <u>Sediment</u> | <u>Biological</u> | <u>Air Quality</u> | |
|------------------------------|------------------------------|--------------|------------------------------|--------------|-------------|-----------------|-------------------|--------------------|----------|
| <u>Analytical Parameters</u> | <u>Dis-</u> <u>solved</u> | <u>Total</u> | <u>Dis-</u> <u>solved</u> | <u>Total</u> | | | | <u>a</u> | <u>b</u> |
| Acidity | | X | | X | | | | | |
| Alkalinity | | X | | X | | | | | |
| Aluminum | X | X | X | X | X | X | X | X | X |
| Antimony | X | X | X | X | X | X | X | X | X |
| Arsenic | X | X | X | X | X | X | X | X | X |
| Asbestos | | | | | | | | X | X |
| Barium | X | X | X | X | X | X | X | X | X |
| Beryllium | X | X | X | X | X | X | X | X | X |
| Cadmium | X | X | X | X | X | X | X | X | X |
| Calcium | X | X | X | X | X | X | X | X | X |
| Chromium | X | X | X | X | X | X | X | X | X |
| Cobalt | X | X | X | X | X | X | X | X | X |
| Copper | X | X | X | X | X | X | X | X | X |
| Cyanide | | X | | X | X | X | | | |
| Gross Alpha | | * | | * | * | * | | | |
| Gross Beta | | * | | * | * | * | | | |
| Iron | X | X | X | X | X | X | X | X | X |
| Lead | X | X | X | X | X | X | X | X | X |
| Magnesium | X | X | X | X | X | X | X | X | X |
| Manganese | X | X | X | X | X | X | X | X | X |
| Mercury | X | X | X | X | X | X | X | X | X |
| Nickel | X | X | X | X | X | X | X | X | X |
| Potassium | X | X | X | X | X | X | X | X | X |
| Radium | | * | | * | * | * | | | |
| Selenium | X | X | X | X | X | X | X | X | X |
| Silver | X | X | X | X | X | X | X | X | X |
| Sodium | X | X | X | X | X | X | X | X | X |
| Sulfate | | X | | X | | | | | |
| Thallium | X | X | X | X | | | | X | X |
| Tin | X | X | X | X | X | X | X | X | x |
| Total Dissolved Solids | | X | | X | | | | | |

Table 7-1
(continued)

| <u>Investigation</u> | <u>Groundwater</u> | | <u>Surface Water</u> | | <u>Soil</u> | <u>Sediment</u> | <u>Biological</u> | <u>Air Quality</u> | |
|------------------------------|------------------------------|--------------|------------------------------|--------------|-------------|-----------------|-------------------|--------------------|----------|
| <u>Analytical Parameters</u> | <u>Dis-</u> <u>solved</u> | <u>Total</u> | <u>Dis-</u> <u>solved</u> | <u>Total</u> | | | | <u>a</u> | <u>b</u> |
| Vanadium | X | X | X | X | X | X | X | X | X |
| XRF ^a | | | | | | | | X | X |
| XPD ^b | | | | | | | | X | * |
| Zinc | X | X | X | X | X | X | X | X | X |

X--All samples.

*--Selected samples.

^aX-Ray Fluorescence fingerprint.

^bX-Ray Diffraction fingerprint.

^cSpecific information under a) refers to bulk material samples and information under b) refers to airborne particulate filter samples.

DE/CC/151

7.6 ANALYTICAL METHODS

A detailed discussion of analytical methodologies is presented in the LAP. The LAP includes a table that contains the following information for each analytical parameter:

- o Sample matrix
- o Analytical method reference
- o Sample holding time

The analytical method reference will correspond to the specific procedure that is followed in the laboratory for the analysis of a particular parameter in a particular matrix.

Whenever possible, analytical procedures will follow methods and techniques consistent with and equivalent to those defined under the contract for EPA Contract Laboratory Program (CLP). The reader is referred to the User's Guide to the Contract Laboratory Program (EPA, 1984b).

If an EPA-approved method is used, a citation of the method's reference will be sufficient. If no EPA-approved method is available or if the method to be used is a modification of an EPA-approved method, the method will be documented in detail in the LAP and sent to the EPA Region VII lab and/or to the CLP as an SAS request.

8.0 FISCAL INFORMATION

The RI/FS Work Plan for the Cherokee County Galena subsite contains a comprehensive presentation of estimated project costs (EPA, 1985b). Additional discussion of fiscal matters will not be presented in this QAPP.

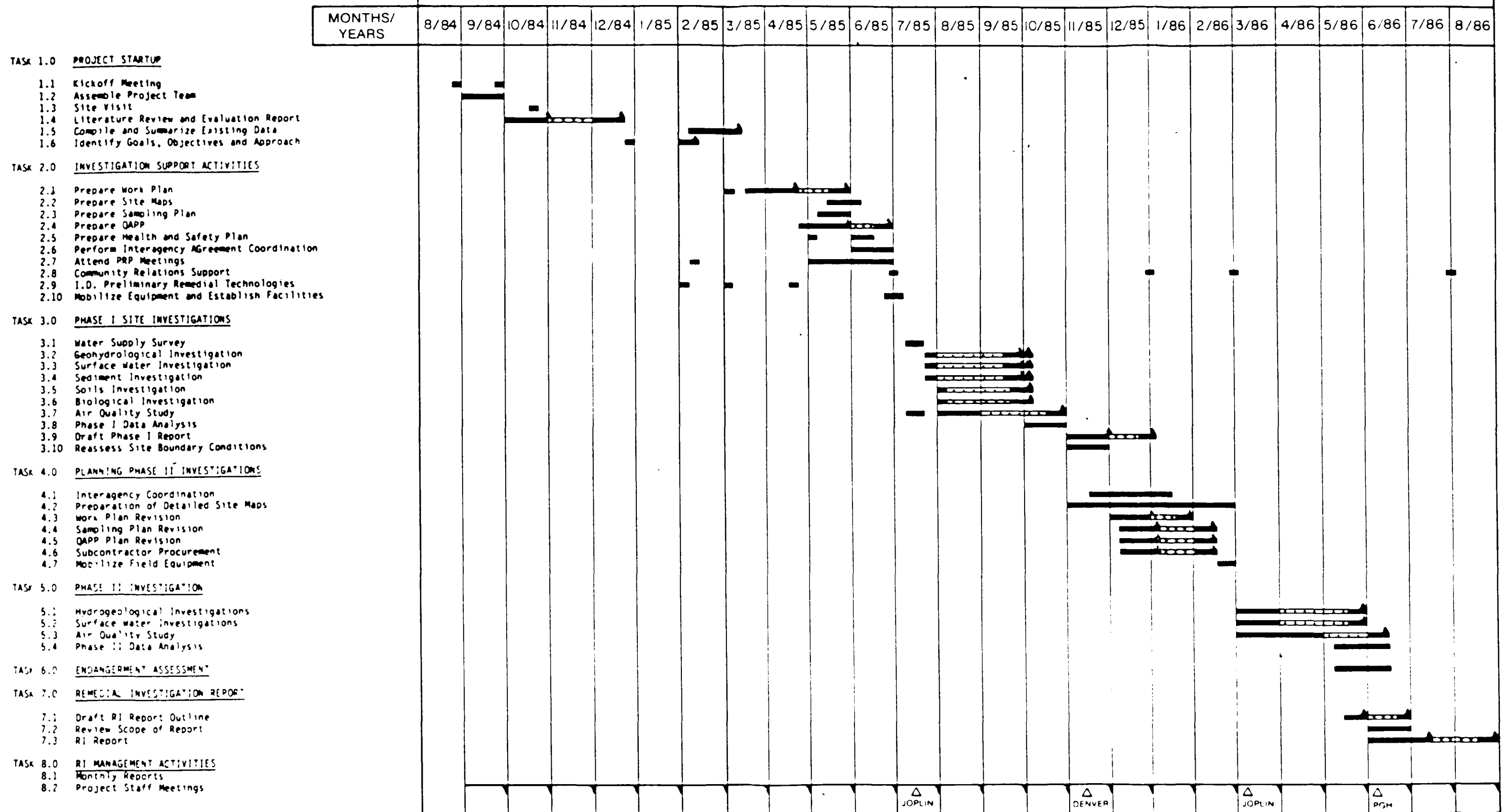
9.0 SCHEDULE OF TASKS AND PRODUCTS

The RI/FS Work Plan for the Cherokee County Galena subsite contains project schedules for the RI and FS (EPA, 1985b). Figure 9-1, Remedial Investigation Schedule, summarizes this information for the Phase I RI.

CHEROKEE COUNTY SITE
GALENA SUBSITE
RI PHASE I AND II PROJECT SCHEDULE

SECTION NO. 9
REVISION No. 1

DATE: 7/23/85
PAGE: 16 OF 35



LEGEND



EPA REVIEW



LAB ANALYSIS



CONTRACTOR ACTIVITY



DRAFT OR FINAL REPORT



ASSUMED LOCATION OF PROJECT STAFF MEETINGS



PITTSBURGH PA



JOPLIN



DENVER



JOPLIN



PITTSBURGH PA

Figure 9-1
Remedial Investigation Schedule

10.0 PROJECT ORGANIZATION AND RESPONSIBILITY

CH2M HILL has overall responsibility for all phases of the RI/FS. SRW Associates Inc. (SRW), a major subcontractor to CH2M HILL for this project, will conduct the majority of the site investigations under the supervision of CH2M HILL. SRW will also have primary responsibility for the FS, with appropriate support and guidance from CH2M HILL.

Figure 10-1 illustrates the project organization and line of authority for the project. Primary responsibility for project quality rests with the Site Project Manager (SPM) and the Regional Project Manager (RPM).

Where quality assurance problems or deficiencies requiring special action are uncovered, the SPM and the SRW RI Project Manager (RIPM) will consult the various QA personnel in order to identify the appropriate corrective action(s). The SPM and RIPM will then be responsible for implementing correction action(s). The Quality Assurance Manager (QAM) and Remedial Planning Team Leader (RPTL) may assist in the identification of appropriate corrective actions and will approve all corrective action.

Field team staffing and responsibility is discussed in Section 2.9 of the FOP, Appendix A.

To facilitate communications, phone numbers and mailing addresses of key project staff members and EPA personnel are presented in Table 10-1.

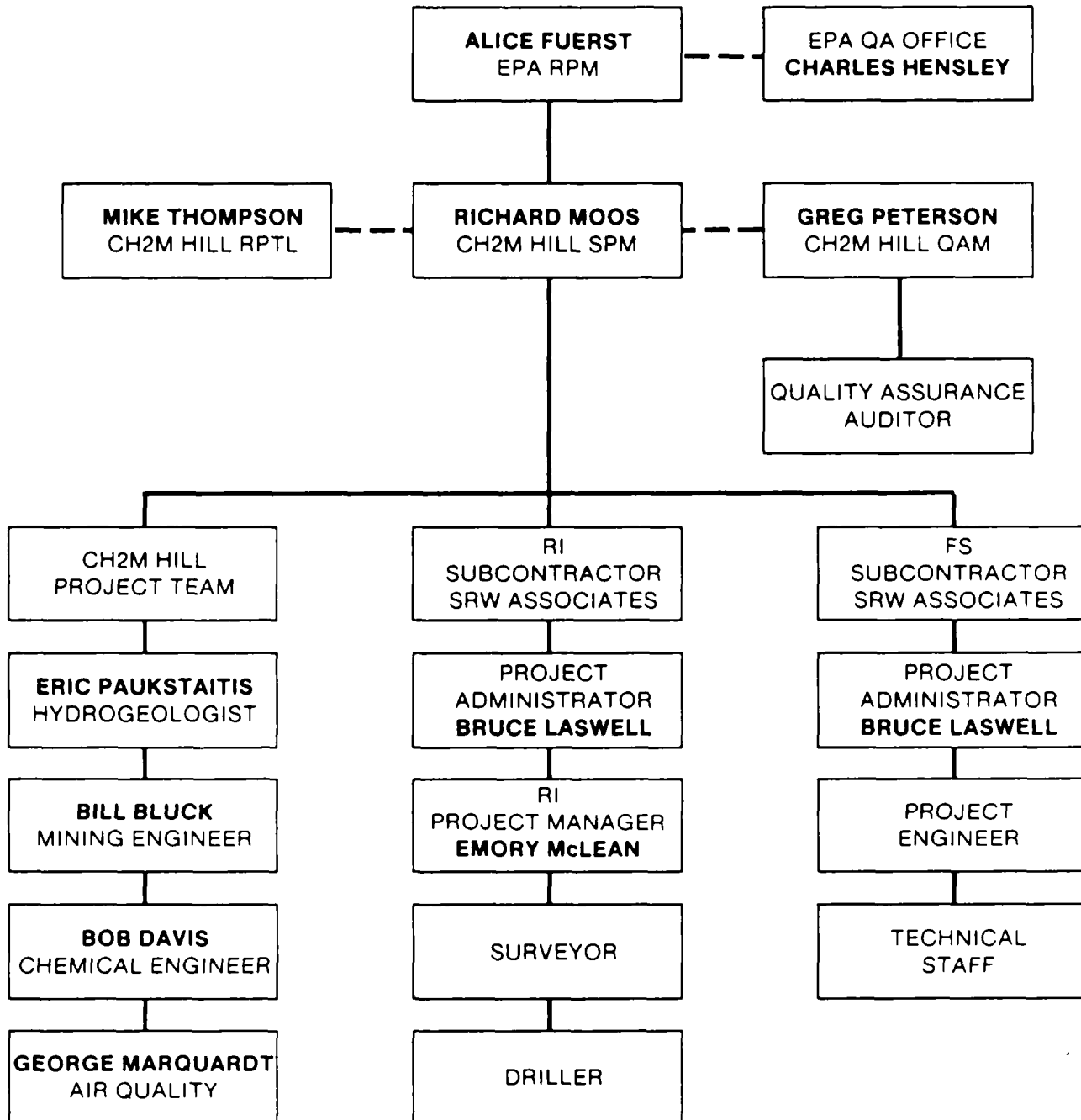


Figure 10-1
Project Organization
Cherokee County RI/FS

Table 10-1
CONTACT INFORMATION FOR KEY PERSONNEL

| <u>Name</u> | <u>Position</u> | <u>Mailing Address</u> | <u>Phone Number</u> |
|-----------------|------------------------------------|---|---------------------|
| Alice Fuerst | EPA-RPM | 726 Minnesota Ave. Kansas City, KS 66101 | 816-374-6864 |
| Charles Hensley | EPA-QA Officer | EPA Region VII Lab 25 Funston Road Kansas City, KS 66115 | 913-236-3881 |
| Dick Moos | CH2M HILL-SPM | P.O. Box 22508 Denver, CO 80222 | 303-771-0900 |
| Mike Thompson | CH2M HILL-RPTL | 8500 College Blvd. Overland Park, KS 66210 | 913-451-5945 |
| Greg Peterson | CH2M HILL-QAM | 2300 NW Walnut Corvallis, OR 97333 | 503-752-4271 |
| Bill Bluck | CH2M HILL-Sr. Technical Advisor | 349 South, 200 East Suite 500, Associated Plaza Salt Lake City, UT 84101 | 801-363-0200 |
| Bruce Lasswell | SRW-PM | 2793 Nobelstown Road Pittsburgh, PA 15205 | 412-921-0321 |
| Emory McLean | SRW-RIPM | 2793 Nobelstown Road Pittsburgh, PA 15205 | 412-921-0321 |

DE/CC/152

11.0 DATA QUALITY REQUIREMENTS AND ASSESSMENTS

The principal objective of the QAPP is to maintain the quality of operational activities at professional standards and document the accuracy of data generation. CH2M HILL and SRW will provide knowledgeable onsite personnel to conduct field operations and ship samples to the CLP. They will also staff the project with personnel experienced in the technical and management disciplines appropriate for the Cherokee County site (see Figure 10-1).

11.1 QA/QC PARAMETERS

The quality assurance objective for analytical data is to collect environmental monitoring data of known and acceptable quality. In order to meet this objective, the following QA/QC parameters will be addressed for all data measurements:

1. Comparability
2. Completeness
3. Representativeness
4. Accuracy

11.1.1 Comparability

The objective behind the assessment of comparability is to assure the data developed during the investigation is comparable with applicable hazard criteria and, where appropriate, with data available from prior scientific studies in the area. Hazard criteria applicable to groundwater and surface water quality have been developed, and criteria to assess potential hazards of soil and air contaminants are being developed. In formulating the LAP, an attempt has been made to specify analyses and analytical methods consistent with those used in developing the hazard criteria.

11.1.2 Completeness

The objective for completeness is that the investigation provide enough of the planned data that the existing data gaps can be closed.

Completeness will be assessed on the basis of numbers of valid samples and distribution of sites at which valid samples were taken. For data to be taken as complete, valid results must be obtained from most identified sampling sites for each of the planned media (i.e., groundwater, surface water, soils, sediments, fish, and air quality samples).

Any deviation from the Phase I Field Operations Plan will be documented by the project. The SPM will present recommendations to the RPM if it is deemed necessary to re-sample any Phase I sampling locations to satisfy the completeness requirements of this initial survey work. The SPM and RPM may decide to incorporate any additional sampling into the Phase II field investigations.

11.1.3 Representativeness

The objective in addressing representativeness is to assess whether the information obtained during the investigation accurately represents the actual site conditions. For the most part, representativeness has been determined during the planning stages of the investigation and is addressed in the following planning documents:

- o Work Plan--During the work planning process existing data and information were reviewed, and a Phase I site investigation has been designed which, given adequate completeness, will yield information representative of site conditions.
- o Field Operations Plan--During the development of the FOP, QC samples (field blanks) were designed into the field sampling process to provide information on external and cross-contamination. These QC samples provide a method for the project staff to detect the occurrence of cross-contamination or external influences, and evaluate the data accordingly. The project staff thus can screen erroneous results which are not representative of site conditions. The FOP also contains proper sample collection techniques (compositing, containerizing, preserving, etc.) and equipment decontamination procedures for obtaining representative samples.
- o Laboratory Analytical Protocol--While the FOP provides the methods for collecting representative samples, the LAP continues the process by providing preparation and analytical methods leading to laboratory measurements representative of the individual samples. The LAP development includes selection of proper preparation, digestion/extraction, and analytical methods for the sample matrices. The LAP also includes proper laboratory QC protocols so that inadvertent sample contamination can be detected and corrected.

Representativeness, for the investigation, will be assessed after initial data validation and reduction and will be based only on validated data.

11.1.4 Accuracy

For the Phase I RI activities at the Galena Subsite, the only accuracy statement that can be generated is for the laboratory. Generation of an overall accuracy statement is not possible or warranted for the Phase I studies. Potential bias due to external or cross-contamination of the samples is addressed under representativeness.

Two types of QC samples will be used during Phase I studies to assess laboratory accuracy. The following priority will be followed with respect to which sample results are used to generate accuracy statements.

1. Laboratory Natural Matrix Spikes (a.k.a Pre-spike)-- These are spikes prepared in the laboratory by splitting a sample and spiking one portion with a known amount of the compounds of interest. The spiked sample result and sample result are compared, and the amount of spike recovered is calculated. The spike recovery is the measure of accuracy. Natural matrix spikes typically work well on homogeneous samples, such as water; but poor recoveries are possible for soil and sediment samples because of the nonhomogeneous nature of the material. It is difficult to assess whether poor natural spike recovery values are due to preparatory and analytical error or to the nonhomogeneous nature of soil and sediment samples.
2. Blind Field Standards--These are certified materials containing known concentrations of chemicals produced by agencies such as EPA, National Bureau of Standards (NBS), and United States Geological Survey (USGS). For Phase I, the EPA Regional Laboratory in Kansas City will supply Field Standards for water, soil and fish. These samples will be submitted blind, along with the natural samples. Although the laboratory is likely to recognize the soil/sediment blind field standards, they do not know the exact chemical composition and concentration. Accuracy statements can be generated by comparing the laboratory results to the mean certified result and applying the methods of Appendix C.

Accuracy statements will be generated based on the spike recoveries. An accuracy statement based on the blind field standards will be generated for the water, fish, and soil analyses. In cases where the frequency of the spikes and blind field standards are equal, an accuracy statement based on both spikes and blind field standards will be developed.

11.2 QA/QC SAMPLES

Data quality will be established through a combination of sample duplicating and field blanks. The number of duplicate and field blank samples to be collected in each sampling episode are presented in Table 11-1.

Table 11-1
QA/QC SAMPLES

| Media | Total No. of Samples | No. of Duplicates | Field Blanks | Field Standards |
|--------------------------------------|-------------------------|----------------------|-----------------|--------------------|
| Groundwater | 44 | 2 | 2 | 2 |
| Surface Water | 38-41 | 2 | 2 | 2 |
| Surface Water (for radioactivity) | 8 | 1 | 1 | 0 |
| Soil | 18 | 1 | 0 | 1 |
| Sediment | 18 | 1 | 0 | 0 |
| Sediment (for radioactivity) | 7 | 1 | 0 | 0 |
| Fish | 6 | 1 | 0 | 1 |
| Airborne Quality | | | | |
| Filter Samples/XRD | 49 | 5 | 4 | 0 |
| Filter Samples/XRF | 134 | 14 | 8 | 0 |
| Filter Samples/ Asbestos | 29 | 3 | 2 | 0 |
| Bulk Samples/XRD | 8-18 | 0 | 0 | 0 |
| Bulk Samples/XPF | 8-18 | 0 | 0 | 0 |

Field blanks for water samples will consist of ultra-pure distilled water. Field blanks for air particulate samples will consist of unused air sampling filters. No field blanks will be used for soil and sediment samples during Phase I. The field blank sample will be placed into the appropriate sampling equipment using procedures that simulate normal sampling, removed from the equipment, and then placed into sampling containers. Preparation of field blanks for fish samples is not feasible.

Duplicate samples will usually consist of two separate samples collected consecutively from the same point with the same sampling equipment and procedures. For air quality samples however, duplicate samples will be two separate samples collected concurrently using collocated samplers.

Blanks and duplicates will be handled in the same way as the natural samples which they accompany. It will be the responsibility of the RIPM to ensure that the QA/QC samples are obtained.

12.0 SAMPLING PROCEDURES AND FIELD MEASUREMENTS

The objectives of sampling procedures and field measurements are to obtain samples and measurements that are representative and comparable. Trace levels of contaminants from external sources should be eliminated through the use of experienced field personnel, good sampling techniques, proper sampling equipment, and adequate decontamination. The inclusion of QA/QC samples, such as field blanks, will check for inadvertent contamination.

A comprehensive discussion of the field operational procedures and the standard operational procedures for Phase I sampling and field measurements are presented in Appendix A and Appendix B.

13.0 SAMPLE CUSTODY AND DOCUMENTATION

All samples collected at Superfund sites for laboratory analysis must follow established documentation protocol. Adherence to this protocol provides a network of information documenting sample identification and tracking as well as chain-of-custody. A complete discussion of the procedures and protocols to be used in sample custody, documentation, handling, and packing are presented in Appendix B, Sections B.7, B.10, and B.11.

14.0 CALIBRATION PROCEDURES AND PREVENTIVE MAINTENANCE

All field equipment used during this project will be operated, maintained, calibrated and standardized in accordance with EPA accepted practices and manufacturer's specifications. Methods and frequencies are described in Appendix B, Section B.12.

An equipment log book will be maintained and will be used to record usage, maintenance, calibration, and repairs.

15.0 ANALYTICAL PROCEDURES

Analytical procedures will follow methods and techniques consistent with and equivalent to those defined under the contract for EPA Contract Laboratory Program (CLP). The reader is referred to the User's Guide to the Contract Laboratory Program (EPA, 1984b). A complete description of all laboratory procedures is presented in the LAP.

16.0 DATA VALIDATION

Reduction of laboratory measurements and laboratory reporting of analytical parameters will be in accordance with the procedures specified for each analytical method (i.e., perform laboratory calculations in accordance with the method specific procedure). Any deviations from the analytical method are delineated in the LAP. Any special reporting requirements (for example, reporting concentrations in soil on a dry or wet weight basis) are also delineated in the LAP. Analytical parameters will be reported in units generally accepted within the industry.

The CLP or EPA laboratories responsible for analyzing the samples will send the analytical data to the Region 7 lab in care of Mr. Charles Hensley. Upon receipt of the laboratory data, the following validation, reduction, and reporting scheme will be executed:

1. Laboratory data will be screened by the Region VII EPA Laboratory for inclusion of and frequency of the necessary QC supporting information (detection limit verification, initial calibration, continuing calibration, duplicates, spikes, reagent blanks, etc.). QC information not included or insufficient frequency will be cause to invalidate the affected measurement data. Request for reanalysis or request for additional QC supporting information can be made at this point.
2. QC supporting information will then be screened by the Regional Lab for QC data outside established control limits. If out-of-control data is discovered, the Regional QA Officer, the RPM, and the SPM will discuss the appropriate corrective action. Any out-of-control data without appropriate corrective action will be cause to invalidate affected measurement data. Request for reanalysis can be made at this point also.
3. The Region 7 lab, at this point, will forward the approved analytical data to the project staff. Measurement data will then be reduced and validated by project staff members following some or all of the procedures described in Appendix C. These procedures consist of:

A. Representativeness

- 1) Comparison of actual sampling procedures to those delineated in the FOP and SOP and other criteria necessary to ensure representativeness.
- 2) Examination of the results of QC blanks and standards for external sample contamination; external contamination will be cause for invalidation.
- 3) Invalidating non-representative data or identifying data to be classified as questionable; only representative data will be used in subsequent data reduction and validation activities.

B. Precision

- 1) Examining duplicate samples for scatter
- 2) Determining if sampling error has occurred by comparing scatter
- 3) Validating data on groups of samples that should all have the same composition by examining the scatter in each group in comparison to the overall scatter (invalid data are discarded)
- 4) Computing an overall relative standard deviation that is applicable to all the field investigation data from a particular sampling campaign

C. Completeness

- 1) Computing the fraction of measurement data that remained valid after discarding any invalid data due to physical, accuracy, or precision reasons (to be computed as a fraction of total planned and total collected samples)

D. Comparability

- 1) Identifying pertinent data characteristics which may limit comparability to other data sets

Section No. 16
Revision No. 1
Date: 7/23/85
Page: 31 of 35

No field reduction or validation will be performed without established written protocols. Where field reduction and validation is to be performed, written protocols are provided in the FOP.

17.0 PERFORMANCE AND SYSTEMS AUDITS

Internal audits will be the responsibility of CH2M HILL's QAM and will be performed on a routine basis. These audits will be scheduled with the RPM and may remain unannounced to CH2M HILL (i.e., the SPM) and the subcontractors. System, evidence, and performance audits will be conducted on a routine basis with the frequency increased if problems are discovered.

Audits will be performed by CH2M HILL's QAM or his representative, the RPM, and selected technical support staff. Subsequent to the audit, CH2M HILL's QAM or his representative will develop an audit report that summarizes those areas requiring corrective measures (if any) and the proposed corrective measures. This report will be submitted to the RPM and resolution of final action will be as described in this QAPP under Section 10.0, Project Organization and Responsibility.

External audits will be performed by EPA at the discretion of the RPM. These audits may or may not be conducted with advance warning to CH2M HILL. The RPM and EPA's QAO will develop a general frequency, time frame, and checklist for external auditing. These audits may be supported by EPA's Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, EPA's Environmental Monitoring Support Laboratory in Cincinnati, Ohio, and/or the National Enforcement Investigations Center in Denver, Colorado. External audit reports, including recommended corrective action, will be the responsibility of EPA.

A comprehensive discussion of the audit program is presented in Appendix D.

18.0 CORRECTIVE ACTION PROCEDURES

In Section 10.0 of this QAPP, Project Organization and Responsibility, responsibility and procedures for identifying corrective actions were delineated. In all cases, corrective action procedures will be coordinated with EPA. In cases where corrective action agreement is not reached between the RPM and CH2M HILL's SPM, EPA will direct, in writing, its final decision on corrective action.

Throughout this QAPP, various control limits have been specified that, if exceeded, require corrective action. These limits include target levels for completeness, minimum QC sample types and frequencies, and criteria for representativeness and comparability. The need for corrective action may also result from performance, system, and evidence audits. EPA will be notified immediately if data do not meet the QA objectives.

Corrective action procedures that might be implemented from audit results or detection of unacceptable data are developed on a case-by-case basis. Such actions may include altering procedures in the field, resampling and/or retesting, using a different batch of containers, or recommending an audit of laboratory procedures. CH2M HILL's SPM is responsible for initiating the corrective action. Laboratory corrective action procedures and responsibility are described in the LAP.

19.0 REPORTS

Monthly technical and financial status reports will be submitted by the CH2M HILL SPM to the EPA RPM. These reports will include an assessment of the project in relation to the proposed schedule, planned technical activities, and estimated costs. The technical report will also address any significant problems identified during normal project operations, during performance and system audits, or during data quality assessments. The SPM will propose corrective action as appropriate. The Cherokee County Galena Subsite Work Plan (EPA, 1985b), includes a list in Section V of other reports and project deliverables that will be submitted to EPA during the RI/FS.

DE/CC/150

REFERENCES

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- EPA. 1984b. Users Guide to the Contract Laboratory Program (CLP). Office of Emergency and Remedial Response, Washington, D.C., October 1984.
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- EPA. 1985b. Work Plan, Remedial Investigation and Feasibility Study--Cherokee County, Galena Subsite. EPA WA No. 127.7L89.0, June 10, 1985.
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APPENDIX A

FIELD OPERATIONS PLAN

| | <u>Page</u> |
|--|-------------|
| 1.0 INTRODUCTION | A1 |
| 1.1 Scope of Field Operations Plan | A1 |
| 2.0 FIELD INVESTIGATION PROCEDURES | A2 |
| 2.1 Introduction | A2 |
| 2.2 Water Supply Survey | A2 |
| 2.3 Hydrogeological Investigation | A4 |
| 2.3.1 Private Well Sampling | A7 |
| 2.3.2 Mine Shaft Sampling | A8 |
| 2.3.3 Surveying | A10 |
| 2.3.4 Hydrogeological Investigation Summary | A10 |
| 2.4 Surface Water Investigation | A11 |
| 2.4.1 River and Creek Sampling | A13 |
| 2.4.2 Empire Lake and Mine Subsidence Sampling | A14 |
| 2.4.3 Surface Water Investigation Summary | A15 |
| 2.5 Sediment Investigation | A17 |
| 2.6 Soils Investigation | A20 |
| 2.6.1 Layout of Composite Sampling Locations | A21 |
| 2.6.2 Sampling | A21 |
| 2.6.3 Soils Investigation Summary | A23 |
| 2.7 Biological Investigation | A24 |
| 2.8 Air Quality Study | A26 |
| 2.9 Field Team Organization and Responsibility | A30 |
| 2.10 Field Investigation Schedule | A31 |

TABLES

| | |
|---------------------------------|-----|
| A.1 Water Supply Inventory Form | A3 |
| A.2 Sampling Data Checklist | A9 |
| A.3 Air Sampler Operator Report | A29 |

FIGURES

| | |
|--|-----|
| II.1 Water Supply Area Survey | A5 |
| II.2 Proposed Groundwater Sampling Locations | A6 |
| II.3 Proposed Surface Water Sampling Locations | A12 |
| II.4 Proposed Sediment Sampling Locations | A18 |
| II.5 Proposed Soil Sampling Locations | A22 |
| II.6 Schedule | A32 |

1.0 INTRODUCTION

This report is the Field Operations Plan for the Phase I Remedial Investigation (RI) to be performed at the Galena Subsite of the Cherokee County site in Galena, Kansas. The work will be performed under EPA Contract No. 68-01-6692, in accordance with the Final Work Plan, Remedial Investigation and Feasibility Study of the Cherokee County Galena Subsite, June 10, 1985.

1.1 SCOPE OF THE FIELD OPERATIONS PLAN

The purpose of the Field Operations Plan (FOP) is to provide detailed operating and sampling instructions for the RI field activities at the Galena Subsite (Figure 7.1). These activities are based on the scope of work presented in the Final Work Plan for the Galena Subsite. The Final Work Plan and this Field Operations Plan focus entirely on the Galena subsite area, as requested by EPA. Investigations at other subsites within the Cherokee County site will be planned and conducted at a later date.

The Final Work Plan provides for a two-phase field investigation. Phase I addresses whether a contamination problem exists and poses a threat to public health. Phase II is an optional investigation phase designed to delineate and evaluate specific problems identified during Phase I and provide the data base, along with Phase I data, necessary to conduct a Feasibility Study. This Field Operations Plan addresses only Phase I field activities. Revisions will be made to the Field Operations Plan if and when Phase II activities are deemed necessary.

The Field Operations Plan addresses the RI field activities only. Non-field activities are not discussed. Complete descriptions of these non-field tasks, along with data evaluation and report preparation activities, are included in the Final Work Plan.

2.0 FIELD INVESTIGATION PROCEDURES

2.1 INTRODUCTION

To assure the safe and efficient execution of field activities, health and safety considerations and sampling procedures will be fully established before the undertaking of any field activities. CH2M Hill and SRW will provide knowledgeable onsite personnel to conduct field operations and staff the project with personnel experienced in the technical and management disciplines appropriate for this site. Adequate sampling and decontamination equipment will be procured and delivered to the site. All field investigation activities will be subject to a site specific Health and Safety Plan which describes appropriate safety precautions (Appendix E).

Sample containers will be provided by EPA through the Sample Management Office (SMO), or by the EPA Region 7 Laboratory for some special sampling requirements.

Site access agreements will be obtained prior to entering any site area.

2.2 WATER SUPPLY SURVEY (TASK RI 3.1)

The water supply survey will be performed to identify the size of the population using private well water in the Galena subsite area and to locate appropriate wells to be sampled during the hydrogeological study.

Detailed Scope: Project personnel will consult with local, state, and county health officials, local well drillers, and the Soil Conservation Service to determine what areas are most likely to be serviced by private water supplies. The State Engineer's Office will be contacted to obtain an inventory of drilling permits issued within the site area. Based on this information, areas to be surveyed will be identified.

Door-to-door surveys will be conducted in the chosen areas. Each head of household will be polled as to the source of their water supply. If the source is a private well, the resident will be questioned as to the construction of the well (if known) and the use of the water. The Water Supply Inventory Form (Table A.1) will be completed for each household surveyed.

Summary: Interview local residents to determine groundwater usage

Number of Samples: 0

WATER SUPPLY INVENTORY FORM
SITE: _____

Owner/User: _____ Date: _____
Address: _____ Project No.: _____
_____ Location No. _____
_____ (as indicated on map)
Phone: _____ Sample No. _____
Description of Location: _____

WATER SOURCE:

_____ Well _____ Cistern _____ Surface Water
_____ Spring _____ Municipal Water Line _____ Other

No. of Persons Using the Water: _____

Water Usage: _____ Drinking _____ Bathing _____ Washing
_____ Watering Lawn _____ Other Household
_____ Livestock _____ Industrial
_____ Other (_____)

DRILLING INFORMATION

Year Well Drilled: _____
Property Owner at Time of Drilling: _____
Drilling Method: _____ Rotary _____ Auger _____ Cable Tool
_____ Hand Dug _____ Other (_____)
Drilling Company: _____

WELL/WATER-SYSTEM CONSTRUCTION

Depth: _____ Casing Length: _____ Casing Material: _____
Pump Capacity: _____ Pump Setting: _____ Holding Tank Size: _____
Diameter: _____ Water Treatment: _____
Depth Where Water Was Encountered During Drilling: _____
Household Piping Material: _____

OTHER

Measured Water Level: _____ Method: _____

Distance from Well to Septic Tank/Leach Field: _____

COMMENTS: _____

Location: As indicated on Figure II.1

Designation of Samples: Not Applicable

Personnel: Field team leader and one sampling technician

Equipment Needed: Clipboards, pens, forms, field map, EPA letter of introduction

Documentation: Water Supply Inventory Form (Table A.1), Field Map locations

Resultant Data: Size of population serviced by groundwater. Extent of usage of the deep and the shallow aquifer.

Special Considerations: Be aware of community relations.

2.3 HYDROGEOLOGICAL INVESTIGATION (TASK RI 3.2)

The groundwater investigation will include sampling approximately 21 private wells identified during the water supply survey and approximately 11 flooded mine shafts in the vicinity of the private wells selected.

The criteria used for selecting private wells for sampling will be based on information concerning water use, aquifers penetrated, lithologic data, well construction, water quality indications from previous studies, and the proximity to abandoned mine areas. Flooded mine shafts will be selected based on proximity to the private wells to be sampled, accessibility, and water quality indicators from previous studies.

Wells to be sampled will be chosen so that they are distributed across the subsite relative to housing density and are located in areas which appear to be hydrogeologically important due to the presence of clusters of mines. General areas meeting these requirements are shown on Figure II.2. In addition, the wells to be sampled should be distributed so that at least three wells are located in each of three or more general areas. This distribution is required to obtain data used for the determination of local and regional groundwater flow direction.

Mine shafts to be sampled will be selected based on proximity to the private wells selected to assess whether mine shaft water quality correlates with the chemical constituents observed in the well samples. Three mine shafts will be sampled at surface, mid-depth and near bottom to investigate the lack of vertical water quality stratification reported previously.

LEGEND
[Hatched Box] PROPOSED WATER SUPPLY
SURVEY AREA

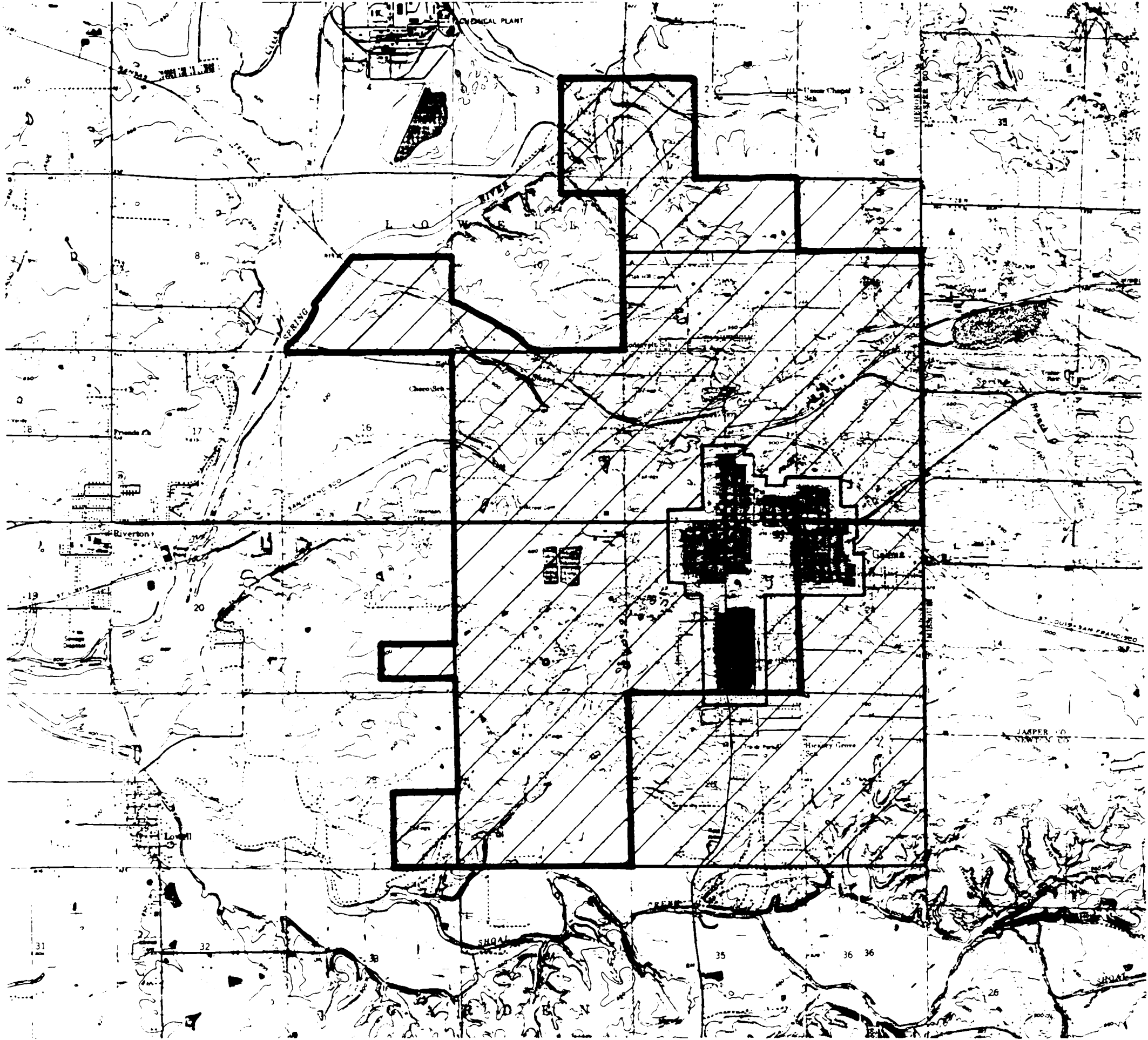
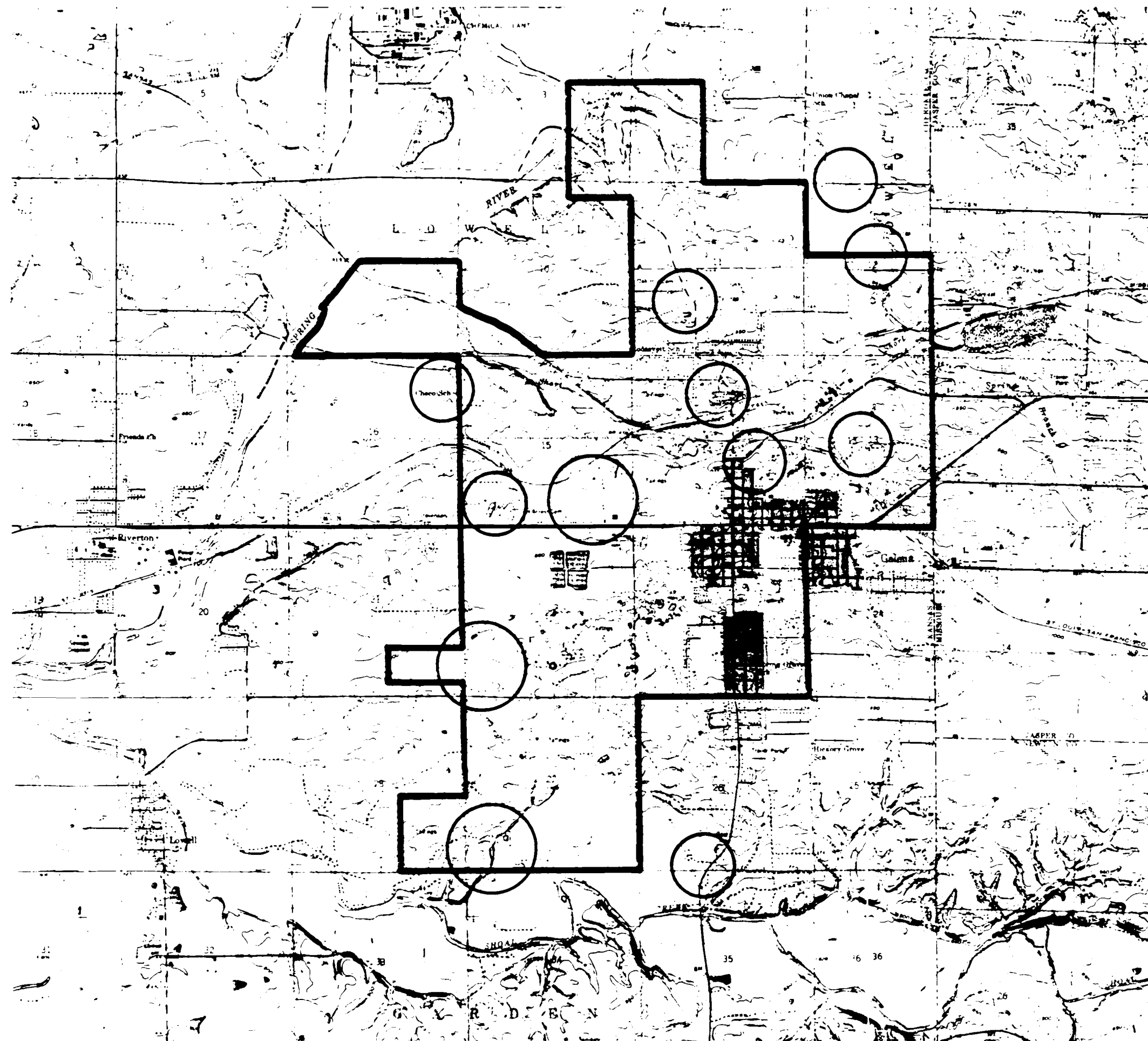


FIGURE II.1
WATER SUPPLY SURVEY AREA
GALENA SUBSITE



LEGEND
○ GROUNDWATER SAMPLE AREA

FIGURE II. 2
PROPOSED GROUNDWATER
SAMPLING LOCATIONS
GALENA SUBSITE

2.3.1 Private Well Sampling

Water levels and water samples will be obtained from the private wells selected for sampling during the water supply survey. The water level in each well will be measured before it is purged. The well owner will be asked if any recent activities may have influenced the water level in the well.

Private well water levels will be measured using the procedures provided in Appendix Section B.1.1 and the measurements will be recorded in the field log book.

Before each well is sampled, the private water supply plumbing system will be inspected to identify an appropriate sampling point. An appropriate sampling point is an existing tap located on the well side of any treatment system. The sample should also be collected from the tap closest to the wellhead. The rationale for selection and description of the sampling point will be recorded in the field log book.

Water will be allowed to flow freely from the tap until temperature, pH, and conductivity stabilize. Measurements of temperature, pH, and conductivity using the procedures in Appendix Sections B.13.12, B.13.5 and B.13.6 will be taken at frequent intervals until two consecutive measurements of each characteristic within the set vary by 10% or less. Changes in temperature, pH, and conductivity during the stabilization period will be recorded in the field log book.

Sample bottles and a stainless steel bucket will be filled directly from the tap discharge. The sample for dissolved metals analysis will be temporarily held in the stainless steel bucket prior to field filtering using the method in Appendix Section B.2. The filtered sample will then be transferred directly to the appropriate sample bottle. An unfiltered sample aliquot will be placed in a clean plastic beaker and be analyzed in the field for pH, temperature and conductivity and the results recorded in the field log book. Sample volumes, bottle types and the numbers of bottles required are indicated in Appendix Section B.8. Individual sample bottles will be filled for total metals, dissolved metals, water chemistry (alkalinity, acidity, sulfate, and total dissolved solids), and cyanide.

Samples will then be preserved in the field as indicated in Appendix Section B.8 and temporarily labeled with a sample number written in permanent marker on the bottle according to Appendix Section B.7. Samples will be decontaminated according to Appendix Section B.9.2 and placed in a cooler for transport to the main field staging area where they will be stored in a refrigerator until shipment. Personnel and equipment decontamination will be performed as detailed in Appendix Sections B.9.1 and B.9.2.

1

1

After sampling activities are completed at each station, the Sampling Data Checklist (Table A.2) should be reviewed and all applicable data and records should be entered into the field log by the Field Team Leader.

Following transport to the main field staging area, complete sample custody and documentation will be performed as described in Appendix Section B.10. Packing and shipping will be performed according to Appendix Section B.11.

2.3.2 Mine Shaft Sampling

Water level, mine shaft depth, and water samples will be obtained from the mine shafts selected during the water supply survey.

Prior to taking any measurements, a flagged stake will be set at the edge of the shaft opening. The stake will be labeled with the station number and also be provided with a reference mark for depth measurements and for location and elevation surveying. Mine shaft water level and mine shaft total depth will be measured using the procedures in Appendix Section B.1.2. These measurements will be recorded in the field log book.

Three of the chosen shafts will be sampled at three depths; near surface, mid-depth, and bottom. All other shafts will be sampled approximately 20 ft. below the water surface or at mid-depth, whichever is shallower. Depths will be measured relative to the reference stake. Samples will be collected using specific depth samplers (e.g. Kemmerer, Van Dorn sampler or point source bailer) which are lowered in the open position to the chosen depth, then closed to retrieve the sample.

Sample bottles and a stainless steel bucket will be filled directly from the sampler. The sample for dissolved metals analysis will be temporarily held in the stainless steel bucket prior to field filtering using the method in Appendix Section B.2. The filtered sample will then be transferred directly to the appropriate sample bottle. An unfiltered sample aliquot will be analyzed in the field for pH, temperature, and conductivity (using the procedures in Appendix Sections B.13.12, B.13.5, and B.13.6) and the results recorded in the field log book. Individual sample bottles will be filled for total metals, dissolved metals, water chemistry and cyanide.

Samples will then be preserved in the field as indicated in Appendix Section B.8 and temporarily labeled with a discrete sample number written in permanent marker on the bottle according to Appendix Section B.7. Samples will be decontaminated according to Appendix Section B.9.2 and placed in a cooler for transport to the main field staging area where they will be stored in a refrigerator until shipment. Personnel and equipment decontamination will be performed as detailed in Appendix Sections B.9.1 and B.9.2.

TABLE A.2
SAMPLING DATA CHECKLIST

The following should be noted in the field log book for each sample collected, as applicable:

General Information:

| | | |
|------------|---------|--------------------|
| Sample No. | Time | Sampling Personnel |
| Date | Weather | |

Methodology:

| | |
|-----------------|---------------------------|
| Sampling Tools | Equipment Decontamination |
| Sampling Method | Filtration |

Location:

| | |
|---|-------|
| Map Location | Depth |
| Nearby features which may affect sample | |

Field Measurements:

| | |
|-------------|-------------------------|
| pH | Electrical Conductivity |
| Temperature | Color (if significant) |

Notes for Specific Media:

| | | | |
|-----------------------|-------------|-----------------------|------------------------------------|
| <u>Groundwater:</u> | Water Level | Method of Measurement | purge time/volume |
| <u>Surface Water:</u> | center | near shore | left bank right bank |
| <u>Sediment:</u> | center | cut bank | point bar depositional environment |

Other:

Special difficulties
Unusual field conditions
Deviation from sampling plan

1

After sampling activities are completed at each station, the Sampling Data Checklist (Table A.2) should be reviewed and all applicable data and records should be entered into the field log by the Field Team Leader.

Following transport to the main field staging area, complete sample custody and documentation will be performed as described in Appendix Section B.10. Packing and shipping will be performed according to Appendix Section B.11.

2.3.3 Surveying

The location and elevation of the private wells and mine shafts that are sampled will be surveyed to correlate water levels and permit groundwater flow gradients and directions to be estimated.

Surveying of groundwater sampling points will be subcontracted. The subcontractor will conform to procedures established by the RIPM and SPM, and presented to the prospective subcontractors as contract specifications.

- Station Marking: Wellheads and mine shafts to be surveyed will be clearly marked and labeled in the field. Wellhead measuring points will be marked with paint. Mine shafts will be marked with stakes. Also, all wells and shafts to be surveyed will be located and labeled on a site map to be presented to the surveying subcontractor.
- The elevation of all selected wells and the stakes at each mine shaft will be surveyed by the subcontractor to ± 0.01 ft. for elevation, and ± 1.0 ft. for locations. Survey data will be tied into an established local benchmark.

2.3.4 Hydrogeological Investigation Summary

Sample groundwater in wells and mine shafts. Measure groundwater levels. Survey sample locations, well elevations, and mine shaft stake elevations.

Number of Samples: 21 well water, 17 mine water, 2 duplicates, 2 audit samples, 2 field blanks. (See Appendix Section B.12 for cross-reference of samples to laboratory analytical requirements.)

Location: From areas indicated on Figure II.2

Personnel: Hydrogeologist and one sampling technician

1

Equipment Needed:

| | |
|--------------------------------|--------------------------------|
| Steel Tape Measure | Kemmerer Type Specific Depth |
| Carpenters Chalk | Sampler or Point Source Bailer |
| Electric Water Level Indicator | Rope |
| Crow Bar | Sample Bottles, Preservatives |
| Hammer | Miscellaneous Wrenches |
| Survey Stakes | Camera |
| Conductivity Meter | pH Meter |
| Filtering Kit | Thermometer |
| | Decontamination Equipment |

Documentation: Water Supply Inventory Form (Table A.1) field map location or surveyed location; Sampling Documentation (Appendix Section B.10); Photographs of Sampling Points

Resultant Data: Chemical quality of shallow groundwater; well and mine shaft water level measurements; mine shaft depths.

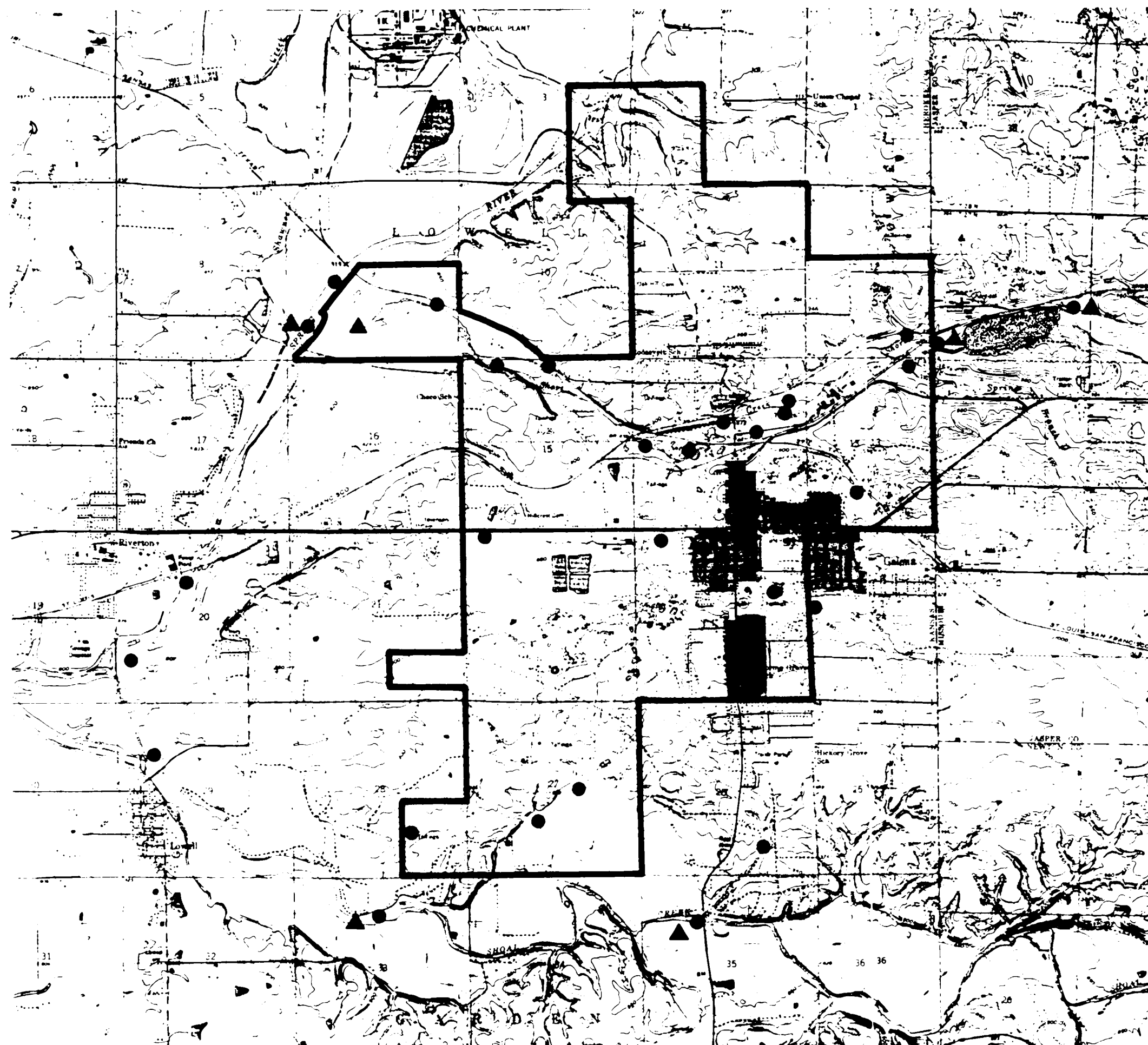
Special Considerations: Be aware of community relations; special safety concerns when sampling mine shafts; prepare both filtered and unfiltered samples for metals analysis.

2.4 SURFACE WATER INVESTIGATION (TASK RI 3.3)

Surface water samples will be collected from Empire Lake on Spring River, Spring River upstream of Empire Lake, Shoal and Short Creeks, tributaries to these creeks and to Spring River, and from mine subsidence areas. The approximate sampling locations are shown on Figure II.3. A field survey will be conducted prior to actual sampling to select specific sampling locations at or near the locations shown on Figure II.3. The following criteria will be used to select the specific sampling stations:

- Water depth adequate for sampling
- Ambient pH and conductivity of the water as determined during the pre-sample survey
- Proximity to abandoned mine areas or other potential contaminant sources
- Visual evidence of acid mine drainage or other contaminants
- Potential of that location being representative of the area
- Ease of access and safety

1



LEGEND
● SURFACE WATER SAMPLING LOCATION
▲ LOCATIONS FOR GROSS ALPHA, GROSS BETA, AND RADIUM

NOTE:
OPTIONAL SAMPLE LOCATIONS WILL BE DETERMINED IN THE FIELD AND ARE NOT SHOWN.

FIGURE II.3
PROPOSED SURFACE WATER
SAMPLING LOCATIONS
GALENA SUBSITE

The sampling locations will be marked on a site map as they are selected. Each sampling station will be numbered and identified by a stake with the station number painted on it. Each station will be photographed and a description of that station will be entered into the field log. The description and photographs will be adequate to allow that sample station to be relocated at some future date by EPA.

2.4.1 River and Creek Sampling

Ambient water temperature, pH, and conductivity will be obtained at the sampling location just prior to sampling. Whenever possible the thermometer or meter probe will be placed directly into the river or creek channel where the sample will be taken. At locations where water depth or access problems prevent direct readings, a water sample will be collected using a plastic beaker attached to a pole, transferred immediately to a clean glass beaker, and tested for temperature, pH, and conductivity. Detailed procedures for determining temperature, pH, and conductivity are presented in Appendix Sections B.13.12, B.13.5 and B.13.6.

Water samples from rivers, creeks, and tributaries will be grab samples, collected as near as possible to the center of the main channel. The water samples will be collected, when possible, by submerging the sample bottle into the stream. The sample bottle will be held upside down and immersed below the surface several inches, then turned upright to fill. This will preclude surface film or floating contaminants from the sample. At locations where water depth or access problems prevent direct readings, a water sample will be collected using a plastic beaker attached to a pole.

Water samples for dissolved metals will be filtered immediately after collection. Procedures for filtering water samples are presented in Appendix Section B.2. The sample bottles will be filled directly from the filtering apparatus discharge.

The water samples will be placed in sample containers and preserved (fixed) as specified in Appendix Section B.8. The filled and preserved samples will then be capped, rinsed with clean water, dried, and labeled. The water samples will be placed in a cooler until field sampling is completed, then held in a refrigerator until shipped. Surface water samples will be analyzed for the parameters listed in Appendix Section B.12 and Table 7.1 of the QAPP.

In addition to collecting samples for total and dissolved metals, separate samples for cyanide analysis will be collected at all surface water sampling stations. The water sample for cyanide will be unfiltered and should be collected directly into the sample container whenever possible. Sample container requirements and preservative methods for cyanide samples are given in Appendix Section B.8.

Water samples for gross alpha, gross beta, and radium analyses will be collected at three stations on Short Creek, two stations on Shoal Creek and one station on Spring River (see Figure II.3). Samples will be collected in one gallon high-density polyethylene containers, capped, rinsed with clean water, and labeled. No preservatives are required, but the samples will be kept in a cool location until shipped.

After sampling activities are completed at each station, the Sampling Data Checklist (Table A.2) will be reviewed and all applicable data and records will be entered into the field log by the Field Team Leader.

All samples will be identified with a discrete sample number (Appendix Section B.7) and labeled with a sample tag. Sample documentation procedures (tags, etc.) are presented in Appendix Section B.10. Packing and shipping procedures are presented in Appendix Section B.11.

Sampling equipment and field crew members will be decontaminated as specified in Appendix Sections B.9.1 and B.9.2 to prevent cross contamination of samples and maintain safety. To further preclude cross contamination, the water samplers will be rinsed with creek water thoroughly just before each sample is collected.

Discharge volume will be calculated based on measurements performed at eight stream and tributary locations on Short Creek to assess if Short Creek is gaining or losing total flow within the stream reach. Water velocities and the cross-sectional area of the stream will be measured at each of the eight sampling stations so the total flow at that location can be calculated. Procedures to measure open-channel flows are given in Appendix Section B.3.

2.4.2 Empire Lake and Mine Subsidence Sampling

Water samples from Empire Lake will be collected along the centerline of the lake, at locations shown on Figure II.3. A temperature profile will be made at each lake station by measuring temperature at one-foot or shorter intervals from the surface to the bottom. The total depth of the lake at the sampling station will be recorded. If the temperature profile indicates a zone where there is a steep temperature gradient (i.e., a rapid change in temperature over a short distance), the lake will be considered as stratified. If the lake is stratified, two samples will be collected at that station, one from the middle of the upper zone (epilimnion) and one from the middle of the lower zone (hypolimnion). If the lake is not stratified, only one sample will be collected. That sample will be taken approximately 10 feet below the surface or at mid-depth, whichever is shallower.

Water temperature, pH, and conductivity at the sample depth(s) will be obtained just prior to sampling. If possible, direct readings should be made using instrument probes. If necessary, however, a water sample can be collected from the proper depth using a point source sampler. The temperature, pH, and conductivity should be measured immediately using procedures in Appendix Sections B.13.12, B.13.5, and B.13.6.

Lake water samples for total metals and cyanide will be transferred directly from the sampler into the proper sample container (Appendix Section B.8). Samples for dissolved metals will be filtered as per procedures in Appendix Section B.2, then placed into the proper sample container. Samples should be preserved (Appendix Section B.8), numbered (Appendix Section B.7), and labeled (Appendix Section B.10) as per standard procedures.

Samples will be placed in a cooler until transported to the main staging area and held in a refrigerator until shipped (Appendix Section B.11).

After sampling activities are completed at each station, the Sampling Data Checklist (Table A.2) should be reviewed and all applicable data and records should be entered into the log book by the Field Team Leader.

Sampling equipment and field crew members will be decontaminated as specified in Appendix Sections B.9.1 and B.9.2 after each station is sampled. Also, at lake stations that are sampled at two depths (epilimnion and hypolimnion), all sampling and filtering equipment must be decontaminated between depths to prevent cross contamination.

Water samples from mine subsidence (depression) areas will be collected using a point source sampler and the same basic procedures as for lake sampling. Temperature, pH, and conductivity will also be measured. The exact sampling location within the depression will be determined by access and safety considerations. The water samples will be taken near the 20-foot depth or shallower. Temperature profiles will not be measured at mine subsidences, but total depth of the subsidence should be recorded if possible.

2.4.3 Surface Water Investigation Summary

Surface water samples will be collected from Short Creek, Shoal Creek, their tributaries, Spring River, Empire Lake, and mine depressions.

Number of Samples:

| | |
|--------------------------|--------------------------------------|
| Short Creek | 7 samples 3 radioactivity samples |
| Short Creek tributaries | 7 samples |
| Shoal Creek | 2 samples 2 radioactivity samples |
| Shoal Creek tributaries | 4 samples |
| Spring River | 2 samples 1 radioactivity sample |
| Spring River tributaries | 1 sample |
| Empire Lake | 3 to 6 samples |
| Subsidence Depressions | 3 samples |
| Optional | 3 samples |
| Duplicates | 2 samples 1 radioactivity sample |
| Audits | 2 samples |
| Field Blanks | 2 samples 1 radioactivity sample |

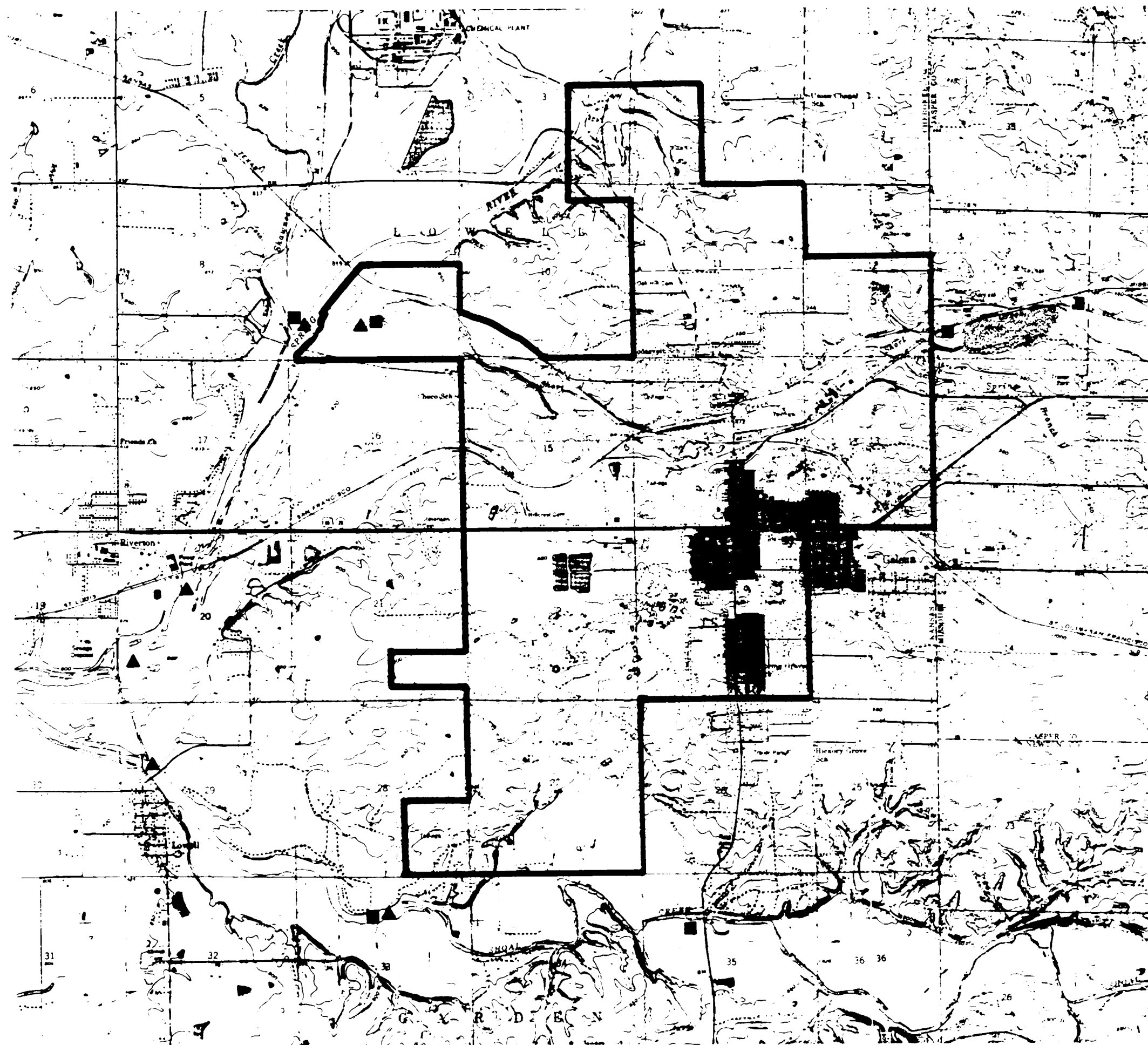
(See Appendix Section B.12 for cross-reference of samples to laboratory analytical requirements.)

Location: As indicated on Figure II.3.

Personnel: Field team leader and one sampling technician.

Equipment Needed:

| | |
|--------------------|---------------------------|
| Thermometer | pH Meter |
| Conductivity Meter | Filtering Kit |
| Bucket | Water Samplers |
| Boat, Motor | Rope |
| Lifejackets | Temperature Probe |
| Sample Bottles | Preservatives |
| Camera | Stop Watch |
| Flow Meter | Tape Measure |
| | Decontamination Equipment |



LEGEND
▲ SEDIMENT SAMPLE LOCATION
■ LOCATION FOR GROSS ALPHA, GROSS BETA, AND RADIUM SEDIMENT SAMPLE

FIGURE II. 4
PROPOSED SEDIMENT SAMPLING
LOCATIONS
GALENA SUBSITE

Documentation: Field Log Book; Sampling Documentation (Appendix Section B.10) field map location; photographs of sampling points.

Resultant Data: Chemical quality of surface water; thermal stratification of Empire Lake; discharge of selected streams.

Special Considerations: Do not sample during or immediately after rainfall; prepare both filtered and non-filtered samples for metals analysis.

2.5 SEDIMENT INVESTIGATION (TASK RI 3.4)

Sediment sampling is intentionally limited during Phase I because the purpose of this task is only to check for the presence or absence of contaminated sediments. If the sediments are contaminated, further investigations will be considered for Phase II.

Sediment samples will be collected from Empire Lake and selected streams at the approximate locations indicated on Figure II.4. A field survey will be conducted prior to actual sampling to select specific sampling locations at or near the locations shown on Figure II.4.

Sediment samples will be obtained at the locations listed and will be analyzed for metals, cyanide and radioactivity (gross alpha, gross beta, and radium) as indicated.

| Location | Analysis |
|--|-----------------------------------|
| 1. Near the Mouth of Short Creek | Metals, Cyanide and Radioactivity |
| 2. Spring River Just Below the Short Creek Confluence | Metals, Cyanide and Radioactivity |
| 3. Three Locations within Empire Lake | Metals, Cyanide |
| 4. Shoal Creek Below the Entrance of all its Tributaries | Metals, Cyanide and Radioactivity |
| 5. Short Creek Above the Fertilizer Plant | Radioactivity Only |
| 6. Short Creek at the State Line | Radioactivity Only |
| 7. Shoal Creek at State Route 26 | Radioactivity Only |

The sampling locations will be marked on a site map as they are selected. Each stream sampling station will be identified by a numbered stake placed above visible high water marks on the bank closest to the sampling location. Each lake station will be located on the field map as the intersection of two compass bearings from visible landmarks. Each station will be photographed and a description of that station will be entered into the field log. The description and photographs will be adequate to allow the sample station to be relocated at some future date by EPA.

Stream sediment grab samples will be collected directly into the sample container if wading is feasible or by using a pipe dredge if water depth or current speed prohibits wading. When collecting directly into the sample container, the open container will be pushed, open end down, about 4 inches into the sediment then turned vertically and capped. Where wading is prohibited due to water depth or current speed, a pipe dredge will be used to collect sediment samples. The pipe dredge is a 6 inch diameter stainless steel pipe 2 ft. in length, capped on one end and open on the other end. The pipe is suspended by a wire bridle and rope. The pipe dredge is cast outward; allowed to sink to the bottom then is drawn across the bottom to collect sediment. The sediment is removed from the sampler and placed in the sample bottle by pouring or through use of a stainless steel trowel.

Individual samples for gross alpha, gross beta, and radium will be collected in sufficient volume to fill a single 1-liter wide-mouth polyethylene bottle. All other individual samples will be collected in sufficient volume to fill one 8-ounce glass jar.

Samples will be preserved in the field as indicated in Appendix Section B.8 and temporarily labeled with a sample number written in permanent marker on the bottle according to Appendix Section B.7. Personnel, samples and equipment will be decontaminated according to Appendix Sections B.9.1 and B.9.2, and placed in a cooler for transport to the main field staging area where they will be stored in a refrigerator until shipment.

After sampling activities are completed at each station, the Sampling Data Checklist (Table A.2) should be reviewed and all applicable data and records should be entered into the field log by the Field Team Leader.

Following transport to the main field staging area, complete sample custody and documentation will be performed as described in Appendix Section B.10. Packing and shipping will be performed according to Appendix Section B.11.

Sediment Investigation Summary: Sediment samples will be collected to complement the data obtained from the surface water samples.

| Location | Analysis |
|--|-----------------------------------|
| 1. Near the Mouth of Short Creek | Metals, Cyanide and Radioactivity |
| 2. Spring River Just Below the Short Creek Confluence | Metals, Cyanide and Radioactivity |
| 3. Three Locations within Empire Lake | Metals and Cyanide |
| 4. Shoal Creek Below the Entrance of all its Tributaries | Metals, Cyanide and Radioactivity |
| 5. Short Creek above the Fertilizer Plant | Radioactivity Only |
| 6. Short Creek at the State Line | Radioactivity Only |
| 7. Shoal Creek at State Route 26 | Radioactivity Only |
| 8. Two Duplicates | Metals, Cyanide and Radioactivity |
| 9. One Audit | Metals |

(See Appendix Section B.12 for cross-reference of samples to laboratory analytical requirements.)

Location: As indicated on Figure II.4

Personnel: Field team leader and one sampling technician

Equipment Needed:

| | |
|-----------------|---------------------------|
| Boat, Motor | Rope |
| Sample Bottles | Stainless Steel Trowel |
| Camera | Pipe Dredge |
| Life Preservers | Decontamination Equipment |

Documentation: Field Log Book; Sampling Documentation (Appendix Section B.10) field map location; photographs of sampling points.

Resultant Data: Chemical quality of sediments

Special Considerations: None

2.6 SOILS INVESTIGATION (TASK RI 3.5)

The objective of the soils investigation is to obtain samples to determine if residual metals contamination continues to be present in the soils generally downwind of the Galena abandoned smelter and to evaluate the accuracy and applicability of previous data to present site conditions. This will provide the basis of an assessment of the risks to public health and agricultural and livestock production in the area downwind of the Galena smelter. Data are available from existing scientific reports concerning metal levels in natural "background" soils and in the soils downwind of the Galena smelter during the early 1970's (EPA, 1984 and 1985a).

Composite soil samples will be obtained from two depths at eight locations along two transects downwind from the abandoned Galena smelter. The locations are shown on Figure II.5.

2.6.1 Layout of Composite Sampling Locations:

Two transects will be layed out from the abandoned Galena smelter at azimuths of N 18° E and N 25° W. A transit or other surveying instrument will be used to maintain the proper azimuth as sampling locations are marked. Four sample locations will be identified along each transect line at approximately 3,000, 4,500, 7,000, and 11,500 ft. distant from the abandoned Galena smelter. Modifications to these locations should be made in the field so that a sample is not collected near a road, disturbed mining area, or any other cultural feature which may be a source of metals.

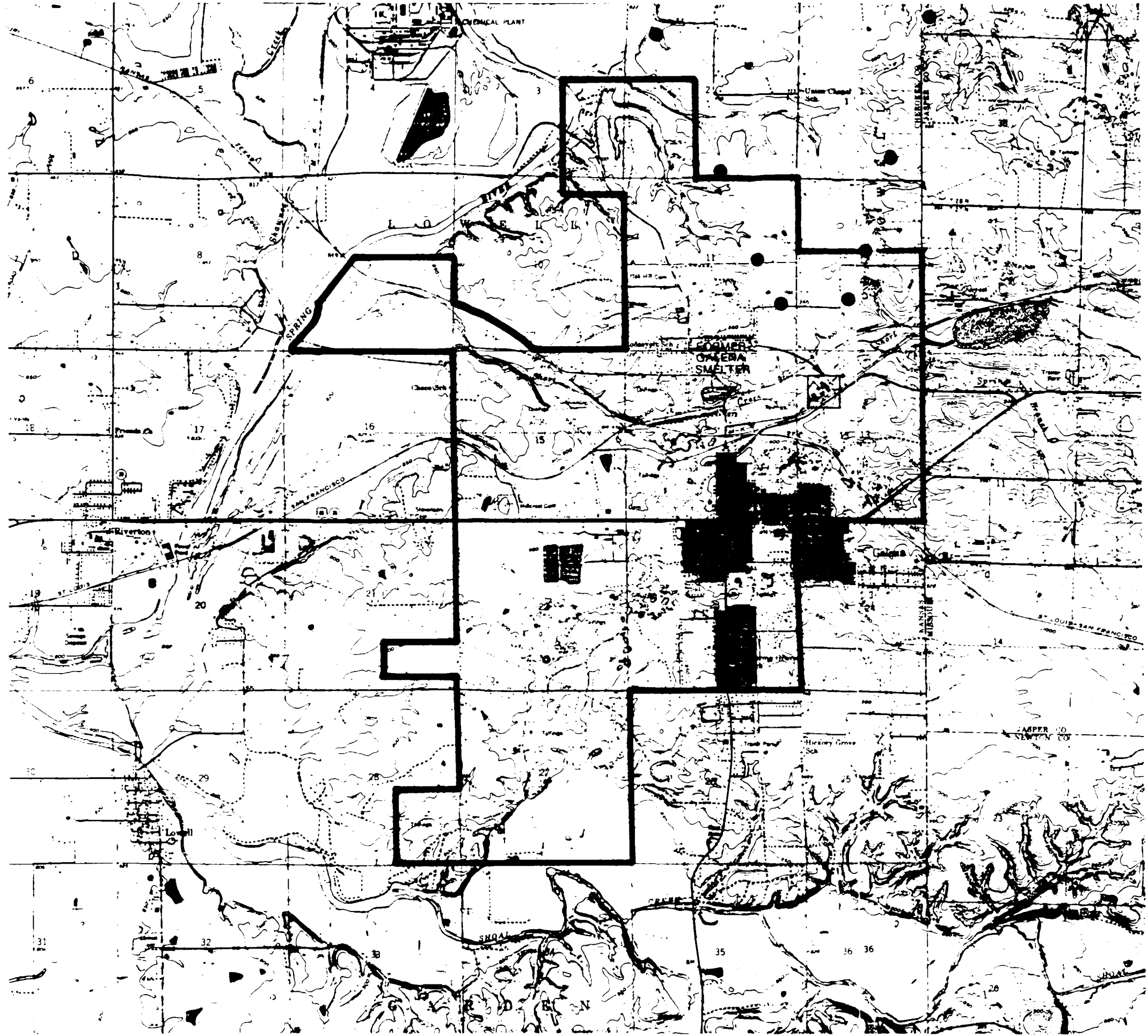
At each location marked above, a 50 ft. sampling square will be marked. The square will be centered on the marked point. Each of the corners and the center point will be used as subsample locations for forming the composite sample.

2.6.2 Sampling

Surficial subsamples will consist of soil material obtained from ground surface to a depth of 6 inches. These subsamples will be collected with a clean hand-powered auger after removing organic material from the ground surface. The auger will be advanced into the soil to a 6 inch depth as indicated by measurement. The auger will be withdrawn from the hole and the material removed using a wooden tongue depressor and placed in a stainless steel bucket. The auger will then be decontaminated as indicated in Appendix Section B.9.2 in preparation for taking the next surficial subsample. All shallow subsamples within a grid will be obtained prior to collecting deep subsamples. The tongue depressor will be discarded to a trash bag.

The auger will be returned to the hole and advanced to 12 inches. The auger will be withdrawn from the hole and the material removed and placed on the ground next to the hole.

Deep subsamples will consist of soil material obtained from a depth of 12 to 18 inches. The clean auger will be returned to the same hole and be advanced into the soil to a depth of 18 inches. The auger and material will be withdrawn from the hole, the soil material removed from the auger using a clean wooden tongue depressor, and the soil placed into a stainless steel bucket. The auger will be decontaminated as indicated in Appendix Section B.9.2 in preparation for obtaining the next deep subsample.



LEGEND
□ FORMER GALENA SMELTER
● PROPOSED SOIL SAMPLE LOCATION

FIGURE II.5
PROPOSED SOIL
SAMPLING LOCATIONS
GALENA SUBSITE

The process of obtaining separate surficial and deep subsamples will be repeated five times within each 50 feet sampling square. A surficial composite sample and a deep composite sample will then be prepared according to Appendix Section B.4.

Samples will be preserved in the field as indicated in Appendix Section B.8 and temporarily labeled with a discrete sample number (Appendix Section B.7) written in permanent marker on the bottle. Personnel, samples and equipment will be decontaminated according to Appendix Sections B.9.1 and B.9.2 and placed in a cooler for transport to the main field staging area where they will be stored in a refrigerator until shipment.

After sampling activities are completed at each station, the Sampling Data Checklist (Table A.2) should be reviewed and all applicable data and records should be entered into the field log by the Field Team Leader.

Following transport to the main field staging area, sample documentation procedures (tags, etc.) will be performed according to Appendix Section B.10. Packing and shipping procedures are presented in Appendix Section B.11.

2.6.3 Soils Investigation Summary

Soil samples will be collected to determine if contamination exists in native soils downwind of the abandoned Galena smelter.

Number of Samples:

8 Surficial
8 Deep
1 Composite Duplicate
1 Audit

(See Appendix Section B.12 for cross-reference of samples to laboratory analytical requirements.)

Location: As indicated on Figure II.5

Personnel: One team leader and one sampling technician

Equipment Needed:

| | |
|---------------------------|-----------------|
| Bucket | Hand Auger |
| Sample Bottles | Shovels |
| Camera | Clean Soil/Sand |
| Decontamination Equipment | |

Documentation: Field Log Book; Sampling Documentation (Appendix Section B.10) field map location; photographs of sampling points.

Resultant Data: Variations in soil chemistry with depth and distance from abandoned smelter.

Special Considerations: Samples should be collected away from roads, residences, mining disturbances, or other man-made features which may affect their metals content other than the abandoned Galena smelter. Give consideration to landowners special requests related to the performance of sampling.

2.7 BIOLOGICAL INVESTIGATION (TASK RI 3.6)

Game fish and forage fish will be collected from Empire Lake to determine if heavy metals are accumulating in fish tissue in quantities that could result in contaminants passing through the food chain to humans. Forage or rough fish will be collected to obtain data that will be comparable to EPA's Ambient Fish Tissue Monitoring Program in Kansas and Missouri. For this purpose, whole body samples of forage fish will be used. To provide a better measure of potential metal intake by humans, the game fish samples will consist only of the fillets with attached skin.

Fish will be collected from at least two locations in Empire Lake, with the assistance of the Kansas Fish and Game Commission and/or EPA. Fish will be collected using an electroshocker, gill, trammel, or hoop nets, or angling. If possible, the game fish and forage fish samples will consist of only one or two species each. Game fish will be bass, sunfish, or catfish while rough fish will be carp or suckers. Three to five fish of 12 in. or less will be collected for each sample. Two game fish and two rough fish samples will be submitted for analysis.

Each fish in the sample will be identified to species, measured to the nearest millimeter (total length) and weighed to the nearest gram. Scale samples will be taken and each fish will be aged by a fisheries biologist. Rough fish will be rinsed with lake water or clean tap water and placed into plastic bags (one bag per sample). Game fish will be filleted and the fillet knife and equipment will be rinsed in clean water between processing each fish. Each sample will be sealed, with sample labels on the inside and outside of the plastic bag. The fish will be held temporarily on ice, returned to the staging area for processing, and shipped on ice or frozen.

Each sample will receive an identification number (Appendix Section B.7), the samples will be labeled and documented as per Appendix Section B.10 and shipped to the laboratory as per Appendix Section B.11 and specific instructions in the LAP.

Summary: Samples of edible and forage fish will be collected to determine if consumption of fish from Empire Lake poses a public health exposure risk.

Number of Samples: Two samples game fish, two samples forage fish (3 to 5 fish in each sample), one duplicate, one audit. (See Appendix Section B.12) for cross-reference of samples to analytical laboratory requirements.)

Personnel: One field team leader, one sampling technician, State fisheries and/or EPA representative

Equipment Needed:

| | |
|----------------|--|
| Boat and Motor | Fish Nets, Angling or Electrofishing Equipment |
| Lifejackets | Sample Bags |
| Knives | Ice/Ice Chest |
| Rule | Camera |
| Scale | |

Documentation: Field Log Book; Sampling Documentation (Appendix B.10); photographs of samples; species identification books; total weight (gms) and length (mm) of each fish.

Resultant Data: Metals content of edible fish and indication of whether metals in nonedible fish may indicate food-chain contamination.

Special Considerations: State assistance with this task has been requested. Obtain State permits or permission for sampling as required.

2.8 AIR QUALITY STUDY (TASK RI 3.7)

Air samples will be collected at the Galena subsite to determine if mine wastes are being transported as airborne particulates from abandoned mine areas, and if these particulates contribute significantly to air quality in the Galena subsite area. Meteorological data will be collected to aid in interpreting the air quality data.

A field survey will be conducted prior to sampling to further define and select potential mining waste sources for study. Potential mining waste sources that may be evaluated during the survey include chat piles, tailings ponds, slag piles, barren mined lands, chat covered gravel roads, and soils near the now inactive smelter at Galena. Five of these potential sources will be selected for study. Criteria for selecting these sources are as follows:

- Isolated from the other sources to the best extent possible.
- Material susceptible to becoming airborne.
- Accessible to the sampling crew.
- Representative of individual sources and not composites of several different types of material.
- In the Galena subsite as defined.

In addition two populated areas and an upwind background location will be selected. The primary objective of the air quality study is to attempt to identify a specific chemical "fingerprint" that will characterize each of the potential sources, then collect airborne particulates to see if the same specific "fingerprints" are present in the particulate samples. The quantity of heavy metals in the particulate samples will also be measured, and the air quality samples will be checked for the presence of asbestos or asbestos-like fibers. Source apportionment determinations will be made using a computer mass balance (CMB) program. Source apportionment and the CMB program will be described in the LAP.

Air quality data to be gathered in the field will include bulk samples of the material from each potential source, ambient air samples for particulates downwind of the potential sources and at an upwind control area, and meteorological data to support the interpretation of the air quality sampling results.

2.8.1 Characterizing the Potential Sources

At each potential mining waste source a composite sample of surface materials will be collected. A total of five composite samples will be taken, assuming that five potential sources are selected for study. Composite surface material samples will also be collected at two populated areas and one upwind background location. This material will be used to "fingerprint" surface material from these areas. In addition, surface material from any source in the proximity of the air monitoring stations (such as roads, highways, etc.) that may influence the samples will be sampled to determine a "fingerprint" for that specific source. It is estimated that 10 samples of this type will be collected. A stainless steel trowel or similar tool will be used to collect the surface material at each sampling point and transfer it into an 8-ounce glass sample container (obtained from the Contract Laboratory Program). The trowel will be decontaminated between each sampling event.

The "fingerprints" from the potential sources (from 8 to 18) will be used in the Computer Mass Balance (CMB) program for source appointment determination as described in the Laboratory Analytical Procedures (LAP) document.

After sampling activities are completed at each station, the Sampling Data Checklist (Table A.2) will be reviewed and all applicable data and records will be entered into the field log by the field team leader.

Sampling equipment and field crew members will be decontaminated as specified in Appendix Sections B.9.1 and B.9.2 to prevent cross contamination of samples and maintain personnel safety.

All samples will be identified with a discrete sample number (Appendix Section B.7) and labeled with a sample tag. Sample documentation

procedures (tags, etc.) are presented in Appendix Section B.10. Samples will be packed and shipped using the procedures presented in Appendix Section B.11.

The samples will be sent to a qualified subcontractor to be analyzed by XRF. X-ray fluorescence (XRF) techniques will be used to determine "fingerprints" of each source, if possible. Selected samples will also be sent to the same laboratory or another qualified subcontractor to be analyzed by XRD. X-ray diffraction (XRD) techniques will be used to determine "fingerprints" of each potential source, if possible.

Purposes of performing both XRF and XRD analysis are as follows:

- o Qualitative XRD analysis will indentify different valence and oxidized forms of compounds. This is important because elemental analysis by XRF will quantify total concentrations of an element, but not all of the different oxidized forms of that element. The valence of some elements influences the toxicity of that element, threfore, it is best to analyze by both XRD and XRF.
- o This will provide a comparison of "fingerprinting" by two different methodologies.
- o This will also provide a comparison of elemental analysis by XRF with compound analysis by XRD methodologies.

2.8.2 Ambient Particulate Sampling

After "fingerprints" have been established for each potential source, High Volume Total Suspended Particulate (TSP) Samplers will be installed at five locations downwind of potential mining waste sources, at two locations in the populated area of Galena and at one upwind background location. In addition, a collocated TSP sampler will be installed at one downwind location to collect duplicate samples. Nine samplers will be required for this study.

The High Volume TSP sampler will be operated at an intake flow rate of 40 standard cubic feet per minute (SCFM) to collect a particulate sample on a 8-inch by 10-inch Teflon filter. These samplers automatically correct for flow changes due to filter loading, line voltage, and pressure changes and have precision flow meters and timers. A built-in programmable timer turns the sampler on and off at preselected times. These samplers operate on 110 volt AC power and will require a generator if line power is not available. These samplers and Teflon filters are acceptable for analysis of asbestos material as well as for analysis of typical airborne particulates.

Twenty-four hour particulate samples will be collected daily (12 noon to 12 noon) at each of the nine samplers over a 14-day period, resulting in

126 samples. In addition 8 blank filters will be submitted as quality control samples. A total of 134 samples will be taken.

The procedures used to remove the filter (particulate sample) and set up the sampler for the next sample period are given in Appendix Section B.5. The air sampler will be preprogramed to collect a 22-hour sample from 12 noon to 10 a.m. the following day. As explained in Section B.5, the 22-hour sample is representative of a 24-hour sample period. The sampler filter will be removed sometime during the downtime period (10.01 a.m. to 11:59 a.m.), a new filter will be installed, and the sampler will be serviced. The High Volume TSP air samplers will be calibrated and maintained in accordance with the manufacturer's specifications presented in Appendix Section B.12.13.

The Air Sampler Operator Report (Table A.3) will be filled out to document the filter number, start and stop time, initial and final flow rate, data, operator, station number, and air sampler serial number. Any unusual events or comments will be recorded on the operator report or in the field log book.

Table A.3
AIR SAMPLER OPERATOR REPORT

Operator: _____ Calibrated Last: _____
Station No.: _____ Sampler Serial No.: _____

| Date | Filter No. | Time (min.) | | | Flow Rate (SCFM)* | |
|------|---------------|-------------|------|-------|-------------------|-------|
| | | Start | Stop | Total | Initial | Final |

*Standardized cubic feet per minute.

Comments:

At the end of the 14-day sampling period the particulate samples will be submitted for "fingerprint" determination utilizing both XRF and XRD technology, for metals analysis by XRF, and for asbestos analysis by both phase contrast and electron microscopy.

Each of the 134 particulate filters will be cut into three equal portions. One hundred and thirty-four one-third portions will be analyzed by XRF; 49 one-third portions will be analyzed by XRD; and 29 one-third portions

will be analyzed for asbestos. All 29 samples submitted for asbestos analysis will be analyzed by phase contract microscopy and at least 12 will also be analyzed by electron microscopy. All remaining one-third portions not analyzed will be archived for possible future use.

All samples will be identified with a discrete sample number (Appendix B.7) and labeled with a sample tag (Appendix Section B.10). Sample documentation and chain-of-custody procedures are presented in Appendix Section B.10. Packing and shipping procedure are presented in Appendix Section B.11.

2.8.3 Meteorological Monitoring

A Climatronics Electronic Weather Station (EWS) will be installed at a location considered representative of the ambient weather conditions in the area. This battery operated EWS system will monitor and record wind speed, wind direction, relative humidity, and temperature for the 2 week sampling period. The EWS operates on battery power and will require a battery replacement after 30 days of continuous use. The EWS will be operated, maintained, and calibrated as per procedures in Appendix Sections B.6 and B.13.11.

2.8.4 Summary

Materials from five mining waste sources that are potential sources of airborne particulates, two populated areas, one upwind location and up to 10 other sources, will be "fingerprinted" using XRD analyses. Then ambient air particulate samples will be collected downwind of the potential mining waste sources, populated areas, and upwind location.

Number of Samples: One composite sample of surface material from each of 18 potential air contaminant sources, and 134 ambient particulate samples will be collected. (See Appendix Section B.12 for cross-reference of samples to laboratory analytical requirements).

Location: To be determined by a field survey.

Designation of Samples: AR

Personnel: An Air Quality Specialist and field technician will establish the samplers and sample the potential sources. A sampling technician trained specifically to service the samplers will collect the particulate samples.

Equipment Needed:

| | |
|--|------------------------|
| Constant Flow Air Samplers | Camera |
| Sample Containers for bulk samples | Calibrator |
| Sample Filters | Air Sampler Operator |
| Batteries and Charger | Meteorological Station |
| Stainless Steel Trowel | Reports |
| Petri Dishes for air particulate samples | |

Documentation: Field log book, map of sampling stations, air sampler operators report, sampling documentation as per Appendix B.10, photographs of sampling locations, meteorological data strip charts and data cassette tapes from the meteorological station.

Resultant Data: Ambient air quality particulate data upwind and downwind of potential sources to determine concentrations of heavy metals and asbestos, meteorological station data, and fingerprinting data to characterize the potential sources.

Special Considerations: Meteorological data will be correlated with ambient samples. Each particulate sample (filter) will be used for XRD and XRF analysis, metals analysis, and asbestos test as previously discussed in Section 2.8.2.

2.9 FIELD TEAM ORGANIZATION AND RESPONSIBILITY

The project field team will be organized according to the site activities. For on-site work, the actual team makeup will depend on the type of activity, but will consist of some combination of the following:

- o RI Project Manager: Will be responsible for planning of field activities, assignment of field team members to sampling teams, maintenance of the project log book, and briefing of team members on their duties and responsibilities. Will be on site during field activities.
- o Site Safety Officer: Will be a CH2M HILL approved individual responsible for selecting level of protection and enforcing the site Health and Safety Plan throughout the Phase I field activities. Will assure that proper precautions are taken to minimize risk to field personnel.
- o Field Team Leader: Will be a sampling team leader assigned by the RI Project Manager, responsible for coordination of specific field investigations, field equipment, and maintaining compliance with the Health and Safety Plan. The field team leader will maintain assigned field log book and documentation of sampling activities and will act as the representative of the Project Manager when performing field tasks located away from the main base of operations.
- o Sampling Technicians: Will be responsible for proper collection and handling of samples, and will take photographs as necessary.
- o Documentation Coordinator: Will be responsible for preparing appropriate forms to document sampling and for properly packing samples for shipment. Oversees and checks chain-of-custody and sample shipping paperwork during Phase I.

Field personnel must satisfy general and site-specific training requirements. Personnel involved in onsite work must have successfully completed the 40 hour Hazardous Waste Site Investigation Training Course. In addition, the Site Safety Officer and at least two members of each sampling team will have successfully completed the American Red Cross Multimedia Standard First Aid and Basic Life Support Course and Cardiopulmonary Resuscitation Course. Personnel assigned to operate field equipment must be qualified to operate the particular equipment they will be using.

For site-specific training, field personnel will receive the Field Operations Plan and the Site Safety Plan in a timely manner to allow for a sufficient review period. Prior to the initiation of site activities, a field staff orientation and briefing will be held to acquaint personnel with the site, with the operation of any unfamiliar sampling equipment, and to assign field responsibilities. Immediately preceding each phase of site activity, a second briefing shall be held to reinforce safety precautions required on site and to perform a final safety check.

2.10 FIELD INVESTIGATION SCHEDULE

The activities described in this Field Operations Plan have been scheduled as shown in Figure II.6. While every reasonable effort will be made to meet these deadlines, unexpected weather conditions or other conditions beyond normal control may require adjustment of this schedule. A complete schedule for all RI activities is presented in Figure 9.1 of the QAPP.

DE/CC2/030

CH2M HILL
SAMPLE IDENTIFICATION MATRIX

BY: 1 DATE: _____ PROJECT NO: 2

SITE 3

ACTIVITY 4

CASE/SAS NUMBER 5

INSTRUCTIONS

- ONE SI MATRIX PER COOLER
- ANALYSIS CODES COMPLETED BY SAMPLERS IN ACCORDANCE WITH CLP REQUEST
- ONE CONTAINER AND TAG NUMBER PER LINE

NOTES: _____ Date: 7/22/85
 _____ Page 821 of 856

[illegible]

CLP LABORATORY 16 PHONE 16
CHAIN OF CUSTODY NUMBER 17
DATE SHIPPED, CARRIER 18
AIRBILL NUMBER 18

ANALYSIS CODES

| | | |
|----|---|--|
| M | = | Total Metals |
| CN | = | Cyanide |
| W | = | T. Alk., T. Acid, Sulfate, Total Dissolved Solids |
| R | = | gross alpha, gross beta, radium |
| F | = | Fat content |

SAMPLE TYPES GW = GROUND WATER
SW = SURFACE WATER
SE = SEDIMENT
SC = SOIL CORE
-G = GRAB SAMPLE
-C = COMPOSITE
-F = FILTERED
-U = UNFILTERED

EXAMPLE SW-G-F = FILTERED SURFACE WATER GRAB SAMPLE

SAMPLE CODES N = NATURAL SAMPLE
R = REPLICATE
KB = KIMWIPE BLANK
BFS = BLIND FIELD STANDARD
(EPA WATER OR SOIL)
FS = FIELD SPIKE
SB = SOIL BLANK
WB = WATER BLANK
BB = BOTTLE BLANK

BOTTLE SIZE & TYPE

1 L AGB = 1 LITER AMBER GLASS BOTTLE

80 AGB = 80 OZ AMBER GLASS BOTTLE

40 GV = 40 ML GLASS VIAL

1 LPB = 1 LITER POLYETHYLENE BOTTLE

120 WMGV = 120 ML WIDE MOUTH GLASS VIAL

16 WMG = 16 OZ WIDE MOUTH GLASS JAR

8 WMG = 8 OZ WIDE MOUTH GLASS JAR

32 WMG = 32 OZ WIDE MOUTH GLASS JAR

4 WMG = 4 OZ WIDE MOUTH GLASS JAR

CH24 MILL DENVER 1-800-525-7964
SAMPLE MANAGEMENT OFFICE
(PAULA AUSSERER) 703 557-2490
FEDERAL EXPRESS ACCT NO 1000-5629-1

PRESERVATIVE CODE NP = UNPRESERVED
 RNP = REFRIGERATED/ICED AT 4°C OR LOWER
 RP2 = REFRIGERATED/ICED AT 4°C OR LOWER AND
 HNO₃ (NITRIC ACID) ADDITION TO pH ≤ 2
 RP'2 = REFRIGERATED/ICED AT 4° OR LOWER AND
 NaOH (SODIUM HYDROXIDE) ADDITION TO pH ≥ 12

FIGURE B.1

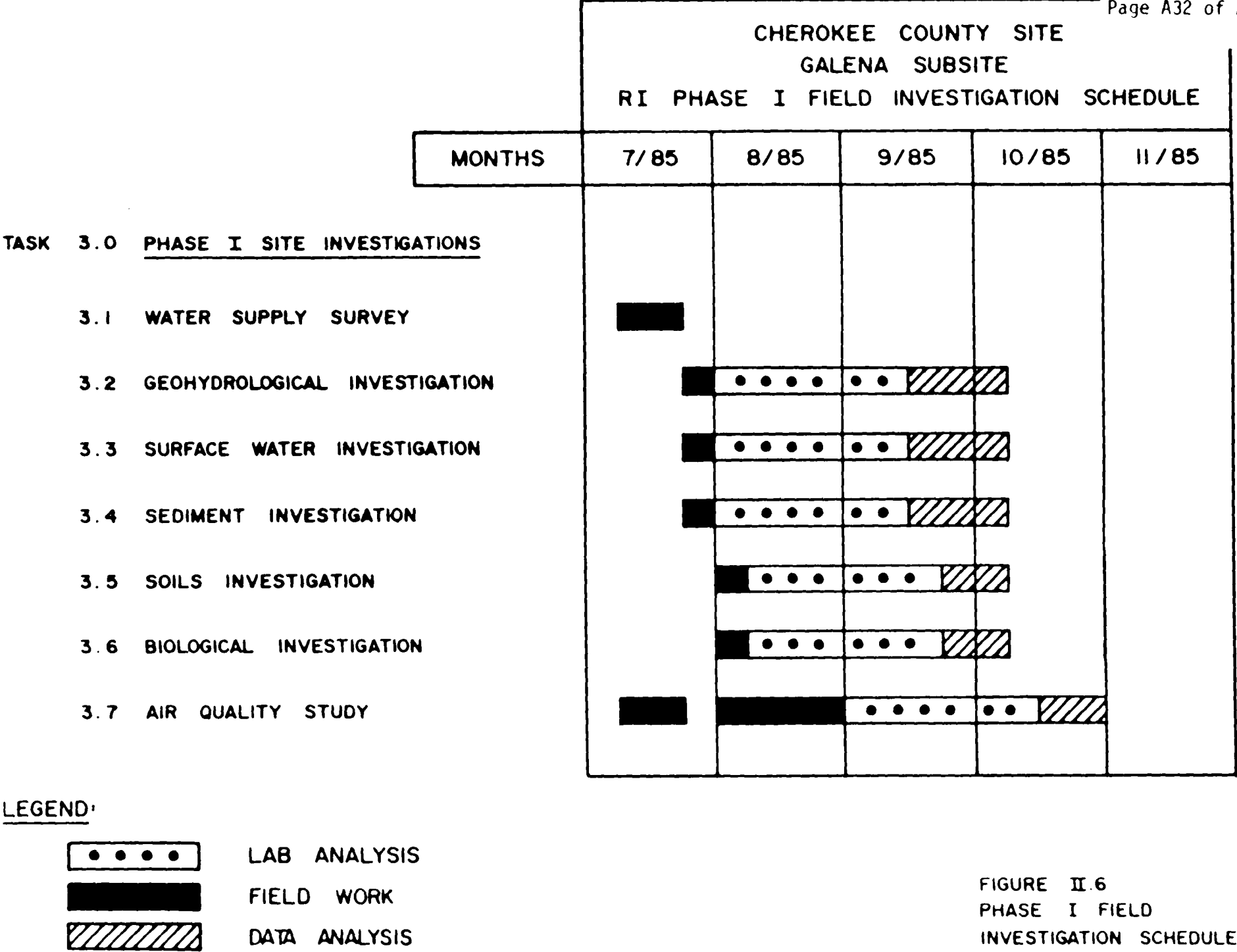
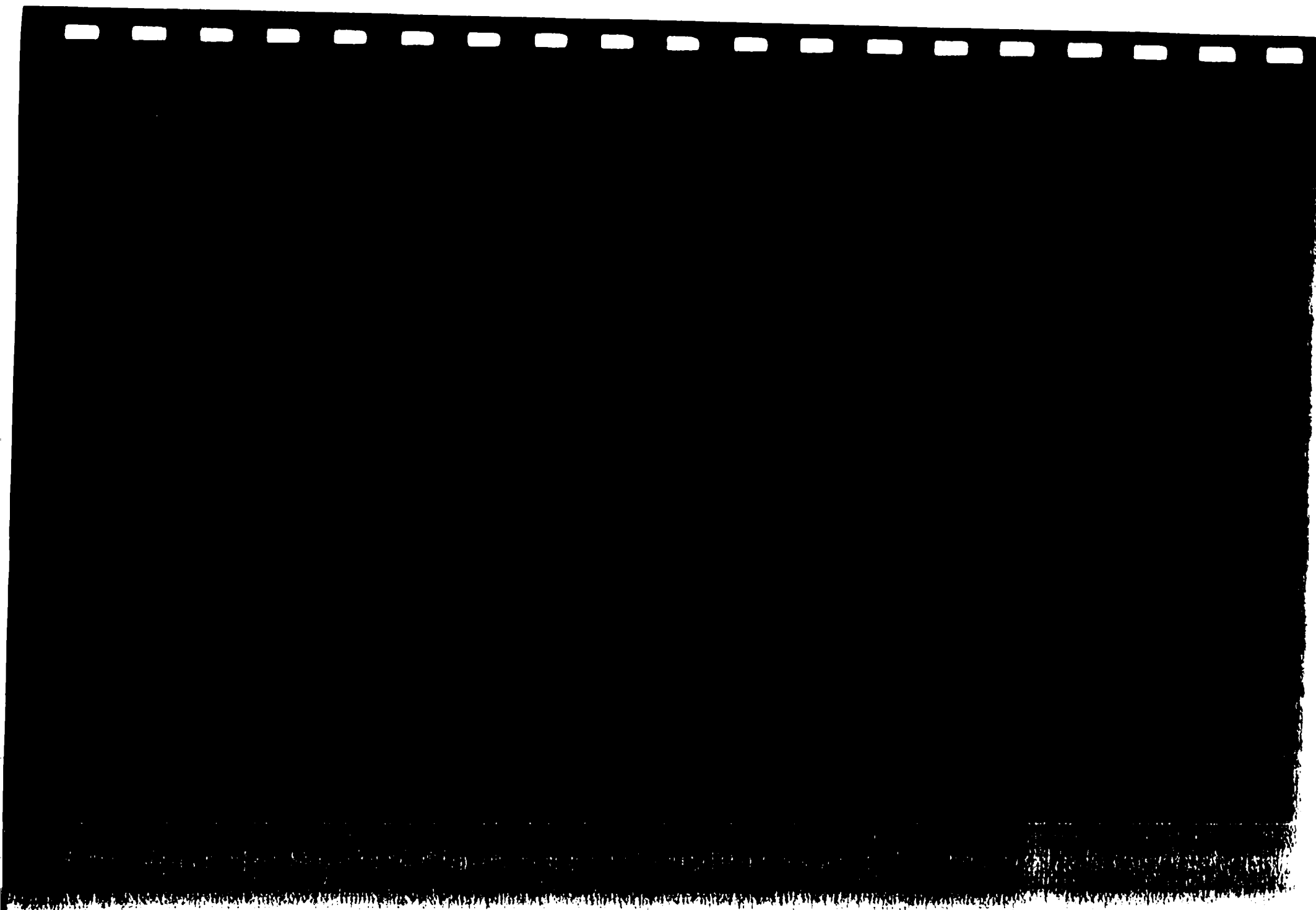


FIGURE II.6
PHASE I FIELD
INVESTIGATION SCHEDULE

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URES

692



APPENDIX B

STANDARD OPERATIONAL PROCEDURES

| | <u>Page</u> |
|---|-------------|
| B.1 WATER LEVELS | B1 |
| B.1.1 Water Levels in Wells | B1 |
| B.1.2 Water Levels and Total Depth of Mine Shafts | B4 |
| B.2 FILTRATION OF DISSOLVED METAL SAMPLES | B5 |
| B.3 OPEN-CHANNEL FLOW MEASUREMENT | B6 |
| B.4 COLLECTION OF COMPOSITE SOIL SAMPLES | B7 |
| B.5 COLLECTING AIR PARTICULATE SAMPLES AND SERVICING THE CONSTANT FLOW AIR SAMPLER | B8 |
| B.6 SERVICING THE METEOROLOGICAL TOWER | B11 |
| B.7 SAMPLE NUMBERING SYSTEM | B11 |
| B.8 SAMPLE QUANTITIES, BOTTLES AND PRESERVATIVES | B12 |
| B.9 DECONTAMINATION PROCEDURES | B12 |
| B.9.1 Personnel | B12 |
| B.9.2 Sample Bottles and Sampling Equipment | B15 |
| B.9.3 Field Vehicles | B15 |
| B.9.4 Disposal of Materials Generated On Site | B15 |
| B.10 INSTRUCTIONS FOR FILLING OUT DOCUMENTATION | B15 |
| B.11 PACKING AND SHIPPING PROCEDURES | B34 |
| B.12 SAMPLING SUMMARY OF LABORATORY REQUIREMENTS | B42 |
| B.13 EQUIPMENT CALIBRATION, OPERATION AND MAINTENANCE | B46 |
| B.13.1 Introduction | B46 |
| B.13.2 Policies of QA Program as Applied to Equipment | B46 |
| B.13.3 Calibration and Field Check Frequencies | B46 |
| B.13.4 Solar Electronics Radiation Alert Mini-Meter | B47 |
| B.13.5 pH Meter | B49 |
| B.13.6 Electrical (Specific) Conductivity Meter | B50 |
| B.13.7 Electrical Water-Level Indicator | B52 |
| B.13.8 Kemmerer or Van Dorn Specific-Depth Sampler | B52 |
| B.13.9 Point-Source Bailer | B53 |
| B.13.10 Pipe Dredge | B53 |
| B.13.11 Climatronics Electronic Weather Station (EWS) | B53 |
| B.13.12 Temperature Measurement | B54 |
| B.13.13 Radon and Radon Daughter Procedure | B55 |
| B.13.14 Anderson Constant-Flow Air Samplers, Series 110 and 120 | B56 |
| TABLES | |
| B.1 Common Domestic Well Caps | B2 |
| B.2 Sample Volumes, Bottles, Preservatives and Holding Times | B13 |
| B.3 Equipment Calibration Schedule | B48 |
| B.4 Sampling Summary | B43 |
| FIGURES | |
| B.1 Sample ID Matrix | B21 |
| B.2 Sample Tag | B23 |
| B.3 Inorganics Traffic Report | B25 |
| B.4 Special Analytical Service Packing List | B27 |
| B.5 EPA Region VII Chain of Custody Record | B29 |
| B.6 EPA Region VII Field Sheet | B31 |
| B.7 Cooler Ready for Shipment | B37 |
| B.8 Federal Express Airbill | B40 |
| B.9 Federal Express Certification for Registered Articles | B41 |

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B.1 WATER LEVELS

Water levels to be determined during Phase I include water levels in wells and water levels in mine shafts.

B.1.1 Water Levels in Wells

Whenever a privately-owned well is to be sampled or opened, permission must first be obtained from the well owner.

Before attempting to measure the water level in a domestic well, determine the accessibility of the well. If the well does not appear that it can be opened without damage, or if the well, when opened, would still not allow measurement, no measurement should be attempted.

Be aware that a well is a major investment and that well owners will be concerned about damage. All equipment entering the well should be scrupulously clean and decontaminated according to Appendix Section B.9.2.

Opening Domestic Wells: Types of well caps used vary generally from ~~driller to driller~~. Caps are usually rusty, so it is wise to carry penetrating oil when planning to open them. Take care that lubricants do not contaminate the water samples. Some of the more common types of caps and techniques for opening them are listed in Table B.1. If the cap can be removed without damaging it, there is generally no danger to the well.

Water Levels in Wells: Weighted-chalked-tape method is preferred. Rub first 5 ft. of a steel tape above the weight with carpenter's chalk. Lower the tape into the well until the end of the tape enters the water as indicated by sound. Record the tape footage at the well head to +0.01 ft. Pull the tape back and read the tape footage of the water mark to +0.01 ft. The difference between the readings is the water level. The Field Team Leader should enter all applicable data into the field log book. Mark the measuring point on the well head so that the exact measuring point can be surveyed.

Because water levels in the existing wells are probably unknown, it may be helpful to first measure the water level with an electric water-level indicator, then refine the measurement with the weighted-chalked-tape. If it is not possible to use the weighted-chalked-tape, the electric water-level indicator may be used, but the fact that it was used and the reason must be recorded in the field log book. Use the procedure described in Appendix Section B.1.2 and apply appropriate correction factors to all electric water-level indicator readings.

TABLE B.1
COMMON DOMESTIC WELL CAPS

| Description | Technique | Tools |
|--------------------------------|--|--|
| Unthreaded Cap with Allen Nuts | (Most common cap). Comes off easily if allen nuts are in good condition and can be loosened with or without penetrating oil. If nuts are rusted, cap can usually be pryed or pounded off because nuts are usually just tightened against solid casing. Prying is preferable to pounding, as it is less likely to upset the well owner. | Allen wrenches Penetrating oil Claw foot Hammer Pry Bar/Crow Bar |
| Threaded Plug-Type Cap | Usually has a square knob on top by which it can be turned with a pipe wrench | Pipe wrench Penetrating oil |
| Internally Threaded Cap | Difficult to open because threads are often long, narrow and rusty. Can sometimes be turned using a chain wrench and plenty of penetrating oil. | Chain wrench Cheater bar Penetrating oil |
| Domed Cap with Access Port | Access port is sometimes sealed with a screw-in plug which can be removed with a wrench, or with a metal plate held in place by screws. Screws may be rusted to the point where they cannot be removed. | Adjustable wrench Screw drivers, various types Penetrating oil |
| Locking Cap | Generally just a set-on cap with a padlock. Should come off easily once lock is removed. May also have allen nuts and would then be opened as the unthreaded cap above. | None |
| Pump Motor on Top of Well | Part or all of the pump mechanism may be installed in a housing set on top of the well head. No attempt should be made to measure water levels in such wells unless an access port is obvious. | Adjustable wrench Screw drivers Penetrating oil |

Table B.1
Page 2
Common Domestic Well Caps

| Description | Technique | Tools |
|-------------|---|--|
| Bolt-on Cap | The cap is held by several bolts to a collar which is welded to the casing. Removing the bolts should free the cap. | 2 Adjustable wrenches Penetrating oil |
| Buried Cap | Cap has been installed below grade and covered with soil. Do not attempt to dig up such a well. | None |

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Decontamination: All equipment used in the measurement of water levels in wells should be decontaminated before and after obtaining water level measurements, as indicated in Appendix Section B.9.2.

Closing Wells: The closing of well access points should be performed in reverse of the method used to gain access.

B.1.2 Water Levels and Total Depth of Mine Shafts

Water Levels in Mine Shafts: Use of the electric water-level indicator is the preferred method for measurement of water levels in mine shafts. Electric probe will be used rather than chalked-tape because chalked-tape does not work well in uncased holes and because the superior accuracy of the tape method is not needed for a shaft which has an unknown irregular structure. Check the instrument battery. Install a survey stake from which the water level can be measured. Lower the probe into the mine shaft. Watch the gauge carefully for the first deflection. Record the water level in the field log book as the distance from the water surface to the staked measurement mark to +0.1 ft. Add the calibration value measured in accordance with Appendix Section B.12.7. Because the probe can give false readings, repeat the measurement and recording process. If the values do not agree, continue to repeat the measurement until a reliable value is obtained. The field log book should show clearly that repeated measurements have been made. Difficulty in access will be handled on a case-by-case basis in the field. It may be necessary to construct an apparatus to lower the probe safely.

Measurement of Depth of Mine Shafts: Attach a weight, such as a metal bar or large bolt weighing approximately 1 to 2 pounds to the end of a steel or fiberglass tape measure. Lower the tape until the tape becomes slack. Shake the tape to assure that the weight is not caught on the side of the shaft. Read the depth from the survey stake installed at the shaft opening to + 1 ft. and enter in the field log book. Do not attempt to measure shaft depth if surface conditions at the shaft opening are unstable or dangerous.

Special Consideration for Large Shafts: In order to accurately measure water levels in large, irregular, or difficult-to-access mine shafts, a leveling device will be constructed. The device will consist of a 2 in. by 4 in. board, at least 5 ft. longer than the diameter of the shaft. At a distance of one-half the board length from the end of the board, a one to two inch diameter pulley will be attached to the board. The pulley will orient such that the rotation of the pulley will be parallel to the length of the board. A mark will be etched or painted on near the end of the board to be used as a reference point for measurements.

The device will be placed across the shaft opening with the electric water-level indicator cable hung through the pulley. The measurement end of the device must be adjacent to the survey stake. The board will be made as level as possible using a carpenter's level; excavations for the board ends may be made with a shovel if necessary.

The water-level indicator will be lowered over the pulley to measure the water level in the shaft. The reading will be made at the etched mark on the leveling device, and the distance between the etched mark and the pulley will be subtracted from the actual reading as a correction.

The leveling device may be used in the same way to measure the total depth of mine shafts.

B.2 FILTRATION OF DISSOLVED METALS SAMPLES

Filter all samples which are being submitted for dissolved-metals analysis. Filtration should be done before the samples are acidified using a pressure filtering device. A Geotech Manufacturing Co. Model No. 0855, 2.4 liter barrel pressure filter will be used.

1. Screw the legs into the base plate.
2. Rinse the base, container portion (upper piece) and screen with sample water.
3. Place the screen on the grid in the base plate. Place a disk of 0.45 micron filter paper over the screen.
4. Fill the container portion with sample water.
5. Make certain the O-ring is in place at the base of the container portion.
6. Turn the base plate, with filter paper, upside down on the container portion. Make sure the two pieces mesh properly.
7. Pull the three bolts on the container section around the base plate and tighten the wing nuts. Nuts need only be finger tight, and should be uniformly tightened.
8. Turn the entire apparatus right-side up.
9. Attach the air-inlet hose, at the top of the apparatus, to a bicycle pump.

- 10. Pressurize the apparatus with the bicycle pump. Water should begin to flow from the outlet hose at the base. Note that over pressurizing this devise can damage it.
- 11. Allow the first cup or so of water to flow onto the ground, to rinse the hose. Then let the hose discharge directly to the sample bottle. When the bottle is filled to 1/4 to 1/2 in. below the neck, remove the discharge hose.
- 12. Add approximately 1 ml of 1:1 Nitric Acid (to pH 2.0) to the sample, screw the cap securely to the bottle and invert to mix.
- 13. Dismantle the filter press, discard the filter paper, and decontaminate the apparatus as indicated in Appendix Section 8.9.2. Store it securely in the carrying case.

B.3 OPEN-CHANNEL FLOW MEASUREMENT

Flow velocity and quantity will be measured at several locations using the velocity-area method. Each measurement will include two parts: measurement of cross-sectional flow area and measurement of flow velocity.

- 1. Select a point of measurement. The point should be easily accessible, representative, and not near features which may cause backwater, including bridge piers, tributaries, and dams.
- 2. Measure the width of the stream at the point of flow measurement using a steel or fiberglass tape. Record the width to ± 0.1 ft. Stretch a rope or line across the stream to act as a transect line.
- 3. Select the number of measurements to be made for the transect:

| <u>Width (ft.)</u> | <u>Minimum Number of Measurements</u> |
|--------------------|---|
| <5 | 3 |
| 5-20 | 5 |
| >20 | 10 |

Make the appropriate number of measurements spaced uniformly across the stream.

- 4. Depth measurements will be made with rod at the same time as the flow velocity measurements. Record depth measurements to ± 0.1 ft.

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5. At each point of measurement, set the flow meter at 0.6 times the total depth below the water surface, with the axis of the meter parallel to the flow direction at that point. Stand behind and to the side of the meter. Rotate the long axis of the meter so that it is parallel with the dominant flow direction. Start the meter and, listening with the headphones, count the meter rotations for one minute or longer. Record the number of rotations and the time in the field log book.

If the direction of flow is not perpendicular to the transect being measured, measure and record the angle between the transect and the direction of flow.

B.4 COLLECTION OF COMPOSITE SOIL SAMPLES

Each soil sample (surficial and deep) will be collected as a set of five subsamples, as described in Section 2.6. These five subsamples must be thoroughly mixed and properly composited in order to provide a representative sample for laboratory analysis.

1. As each subsample is collected, place a standard volume in a stainless steel bucket, along with the other subsamples from that depth group.
2. After all subsamples are in the bucket, stir the sample thoroughly with a decontaminated stainless steel trowel or spatula until the sample is completely mixed.
3. Mix the sample again. Divide the sample into quarters with the trowel or spatula and remove the two opposite quarters of the sample. Continue dividing each split sample in quarters repeatedly until the resultant splits are of the appropriate size to fit into an 8 oz. sample jar.
4. Place an arbitrarily chosen split from the final two halves into the jar using the spatula. Close the jar snugly. Set the remaining portion of the sample aside.
5. Decontaminate the bucket and spatula/trowel according to Appendix Section 8.9.2.
6. Replace the soil set aside during the repeated Step 4 into the auger borings and holes left by sampling. If necessary, add clean sand to bring the subsampling areas back to original grade. Replace the vegetative mat over the disturbed areas.

| | | | | | | | | | | | | | | | | |

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B.5 COLLECTING AIR PARTICULATE SAMPLES AND CALIBRATING THE
GMW HIGH VOLUME AIR SAMPLERS

The General Metal Works (GMW) High Volume Air Sampler consists of a blower/motor unit and a support screen for the 8" x 10" filter, that is supported in a protective shelter that keeps the filter in a horizontal position. The High Volume Sampler operates over a flow range of 20 to 60 standardized cubic feet per minute (SCFM).

Prior to using the High Volume Sampler, select a desired flowrate (usually 40 SCFM) and a sample period. The procedures for calibrating and operating the sampler for particulate sampling are given below.

Calibration: The High Volume Air Sampler should be calibrated for site specific conditions after it has been installed. A calibrating orifice assembly and water manometer (Model GMW-25) unit which is factory calibrated against a positive displacement meter is compared against actual airflow static pressure. This is a multipoint calibration against a series of five resistant plates. Complete procedures are presented on Page 7 of Appendix B.13.14.

Collection of the Sample: The air sampler will be set to collect a 24-hour sample on a daily basis between 12 noon and 11:59 a.m. the next day. The final elapsed time will be recorded on the Air Sampler Operator Report (Table B.3). Any sample duration of 22 to 24 hours will constitute a 24-hour sample. Flowrates and total sampling time will be used to calculate the total volume of air sampled. The sampler will be serviced during the downtime period.

1. Unlock and open the air sampler as per instructions in Appendix B.13.14. Record the final flowrate and elapsed time on the Operator Report (Table A.3) that was started for this sample the day before. Then turn the power off.
2. Remove the exposed teflon filter, leaving the supporting glass filter in place, from the filter support using forceps and surgically gloved hands. Place the filter in the original prelabeled ziplock bag labeled with a discrete sample number (Appendix Section B.7) written in permanent marker. The filters should not be folded and should be kept in a horizontal position. Each filter had been pre-

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weighted inside a ziplock bag and both the bag and filter were numbered with a discrete sample number. Consequently the filters must be placed back in their original matching ziplock bags after each sampling period.

Equipment will be decontaminated according to Appendix Section B.9.2. Samples will be placed horizontally in a cooler for transport to the main field staging area, where they will be stored in a cool dry area until shipment.

Following transport to the main field staging area, sample documentation will be performed in accordance with Appendix Section B.10. Packing and shipping procedures are presented in Appendix Section B.11.

3. Install a clean 8" x 10" teflon membrane filter in the sample head using decontaminated forceps and surgically gloved hands. Be sure to record the filter number on the new Operator Report (Table A.3).
4. Follow the Operating Instructions in Appendix Section B.13.14 to start the sampler; and set the flowrate, timer, and flow recorder. The flowrate will be set at 40 SCFM and the timer will be set to sample from 12 noon to 12 noon. (Note: The Instruction Manual for the High Volume Air Samplers in Appendix Section B.13.14 provides detailed instructions for setting the flowrates, timer, and flow recorder.
5. Complete the new Operator Report (Table A.3), recording start time (elapsed time meter), initial flowrate, date, operator, station number, and air sampler serial number. Any unusual events and comments should also be recorded in the Operator Report or the field log book.

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B.6 SERVICING THE METEOROLOGICAL TOWER

The air quality sampling technician will visit the meteorological tower every day and conduct the following maintenance activities:

1. Check the strip chart recorder and make sure the paper supply is adequate. Also check to make sure the strip chart is not jammed. Replace the chart paper as required (Appendix Section B.13.11).
2. Record the date and time of the daily service on the strip chart recorder.
3. Check the tape supply in the data cassette tape cartridge and replace if necessary (Appendix Section B.13.11).
4. Visually inspect the sensors and the instrument. Look for bent vanes, missing cups, loose cables, or other physical damage.
5. Inspect the data on the strip-chart record, then input the proper sequence of commands on the data logger to obtain instantaneous output of wind velocity, direction, etc. If any values are unreasonable, perform a more complete inspection (Appendix Section B.13.11).
6. If the strip chart or data cassette are replaced, the start time and date is placed on the new chart or cassette and the stop time and date are written on the filled chart or cassette. The charts or cassettes are also labeled with the sample location and sampling instrument number.
7. The data recording checklist will be reviewed and all appropriate information will be written into the field logbook.

B.7 SAMPLE NUMBERING SYSTEM

All samples collected will be assigned a unique EPA Region VII sample number. The sample numbers must be used on all documentation generated for this project. The sample numbering system operates in the following manner:

| <u>EPA Sample No.</u> | <u>Sample</u> |
|-----------------------|---|
| BMHB9001 | Sample Number 1 |
| BMHB9002 | Sample Number 2 |
| BMHB9002D | The "D" appended onto BMHB9002 indicates that |

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BMHB9003F this sample is a duplicate of Sample 2
The "F" appended onto a sample number indica-
tes that this sample is a field blank
BMHB9004P The "P" appended onto a sample number indica-
tes that this sample is a performance eva-
luation audit sample

B.8 SAMPLE QUANTITIES, BOTTLES, AND PRESERVATIVES

Sample quantities, number of sample bottles and bottle types, bottle materials, preservatives, and maximum holding times before analysis are presented in Table B.2. Table B.2 is arranged according to sampling media.

B.9 DECONTAMINATION PROCEDURES

B.9.1 Personnel

After working in mined areas or in dusty areas thoroughly clean or spray boots, especially the soles, prior to getting back into vehicle. Wash hands and face prior to eating, drinking or smoking. Shower, wash hair, and change clothes after each day in the field. Work clothes should be laundered frequently if not wearing tyveks. Use of disposable boots, when practical, would eliminate the need for boot decon.

Boots may be removed and sealed in plastic bags while driving between sampling locations to reduce the need for decon. Boots must be thoroughly washed at the end of each work day.

Clean washwater or premoist towelettes should be available to wash hands and face. Water sprayers will be available for equipment rinse in the field. Plastic garbage bags should be used for tyvek disposal and boot transport.

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TABLE B.2
SAMPLE VOLUMES, BOTTLES, PRESERVATIVES, AND HOLDING TIMES

| | <u>No. of Bottles</u> | <u>Bottle Volume</u> | <u>Bottle Material</u> | <u>Preservatives</u> | <u>Maximum Holding Time Before Analysis</u> |
|---|---------------------------|--------------------------|---|---|---|
| <u>GROUNDWATER AND SURFACE WATER:</u> | | | | | |
| Low Concentration: | | | | | |
| Total Metals ¹ | 1 | 1 liter | high-density polyethylene | 1:1 Nitric Acid to pH <2.0 | 28 days |
| Dissolved Metals ¹ | 1 | 1 liter | high-density polyethylene | Filter on site 1:1 Nitric Acid to pH <2.0 | 28 days |
| Cyanide | 1 | 1 liter | high-density polyethylene | NaOH to pH 12 ³ | 14 days |
| Water-Quality Parameters | 1 | 1 liter | high-density polyethylene | Cool, 4°C | 7 days |
| Radioactivity | 1 | 1 gallon | high-density polyethylene | None | 14 days |
| Medium Concentration: ² | | | | | |
| Total Metals | 1 | 16 oz. | glass | None | Not Established |
| Dissolved Metals | 1 | 16 oz. | glass | None | Not Established |
| Cyanide | 1 | 16 oz. | glass | None | Not Established |
| Water-Quality Parameters | 1 | 1 liter | high-density polyethylene | Cool | 24 hrs. |
| Radioactivity | 1 | 1 gallon | high-density polyethylene | None | 14 days |
| <u>SOIL AND SEDIMENT</u> | | | | | |
| Low or Medium Concentration: | | | | | |
| Extractable Metals and Cyanide | 1 | 8 oz. | glass | Cool to 4°C | Not Established |
| Water-Quality Parameters | Not To Be Performed | | | | |
| Radioactivity | 1 | 1 liter | high-density wide-mouth polyethylene | None | 14 days |
| <u>BIOLOGICAL SAMPLES</u> | | | | | |
| Low or Medium Concentration: | | | | | |
| Total Metals | 1 bag | 1 quart | plastic | Freeze to 0°C | Not Established |
| Fat Content | 1 bag | 1 quart | plastic | Freeze to 0°C | Not Established |

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Table B.2 (continued)
SAMPLE VOLUMES, BOTTLES, PRESERVATIVES,
AND HOLDING TIMES

| | <u>No. of Bottles</u> | <u>Bottle Volume</u> | <u>Bottle Material</u> | <u>Perservatives</u> | <u>Maximum Holding Time Before Analysis</u> |
|-------------------------|---------------------------|--------------------------|------------------------|----------------------|---|
| <u>AIR SAMPLES</u> | | | | | |
| Low Concentration: | | | | | |
| XRF ⁴ | 1 | 8 oz | Glass | None | Not Established |
| XRD ⁴ | 1 | 8 oz | Glass | None | Not Established |
| Metals/XRD ⁵ | 1 ⁶ | 8"x10" | Plastic | None | Not Established |
| Metals/XRF ⁵ | 1 ⁶ | 8"x10" | Plastic | None | Not Established |
| Asbestos ⁵ | 1 ⁶ | 8"x10" | Plastic | None | Not Established |

NOTE: All Samples will be environmental and, therefore, considered low concentration.

1. Holding time controlled by mercury maximum holding time of 28 days.
2. Every medium concentration sample will be sealed in a metal paint can for shipment.
3. Before preserving with NaOH, test sample for presence of sulfide using lead acetate paper. If sulfides are present, add powdered cadmium carbonate until a negative lead acetate paper result is obtained.
On private water supply wells, test for presence of chlorine using iodine-starch test paper. If a blue color results, add ascorbic acid crystals until no color is produced on the iodone-starch test paper.
4. Bulk sample of surface material.
5. Airborne particulate samples will be collected on an 8-inch by 10-inch Teflon-coated filter. Then each filter will be cut into three equal parts. One-third of the filter will be sent for XRF analyses, one-third for XRD analyses, and one-third for asbestos analyses.
6. The airborne particulate sample (filter) will be placed into a pre-weighed plastic zip-lock bag for shipment to the lab.

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B.9.2 Sample Bottles and Sampling Equipment

At the completion of each day's sampling activities and before returning samples to the main staging area for packing and shipping, sample bottles will be decontaminated. Water sample bottles and water sampling equipment will be rinsed thoroughly with tap water and then rinsed with distilled water. Sample jars for soil/sediment samples and soil/sediment sampling equipment will be washed with a detergent solution and a brush, and then rinsed with tap water. Only biodegradable detergents will be used, and they will be used in limited quantities only. All solutions resulting from decontamination procedures will be disposed of on site.

All sampling equipment used in water sampling will be rinsed with tap water and distilled water after each sample has been collected. Full decontamination will also be performed between collection of duplicate samples. It will also be necessary to clean all pieces of equipment used in soil/sediment sampling activities with a brush, mild detergent and tap water if dirt tends to cling to them. Brush cleaning will be followed by a tap water and a distilled water rinse. Rope and cables used to suspend sampling equipment will be decontaminated using a tap water/distilled water rinse between samples. In no case will an instrument which shows visible dirt or soil be used to collect samples without being decontaminated first.

After each use the filter apparatus will be decontaminated by rinsing each piece separately with tap water and then with distilled water. The O-ring and screen will be decontaminated separately, not while left attached to the apparatus.

B.9.3 Field Vehicles

Interiors of field vehicles will be swept and washed with a household solvent cleaner and paper toweling on a regular basis, at least once per week. Washing of the vehicle exterior will be on an as-needed basis.

B.9.4 Disposal of Materials Generated on Site

Place disposable clothing and work-generated waste material in plastic bags and dispose of in county landfill or at solid waste collection facilities affiliated with the county landfill.

B.10 INSTRUCTIONS FOR FILLING OUT DOCUMENTATION

All samples collected at Superfund sites for laboratory analysis must follow established documentation protocol. Adherence to this protocol provides a network of valuable information documenting sample identification and tracking as well as chain-of-custody.

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B.10.1 General Documentation Procedures: Organization and concentration are the keys to completing the required documents efficiently and without error. Make certain that a suitable work area has been set aside with ample table and floor space available for the processing of forms and the packaging of samples. This is especially important for large projects.

Forms, tags, etc. can be filled out in any order; however, past experience has shown that this paperwork can be completed most efficiently and accurately if the sample identification matrix form (Appendix Section B.10.2) is completed before or in conjunction with the completion of the rest of the documentation.

Sections B.10.2 through B.10.8 discuss the proper completion of each document. Use these pages as a reference while following this suggested plan of attack:

1. Make or obtain a list of the samples to be packaged and shipped that same day and the laboratories to be used.
2. Enter the sample type, sample numbers, laboratory, date sampled and date shipped for each sample on the Sample Identification Matrix Form. NOTE: If portions of a given sample are to be shipped to different laboratories (for organic and inorganic analysis for instance), two entry lines will be required for that sample number to accommodate the chain-of-custody record, airbill, and traffic report numbers corresponding to each portion of the sample.
3. Obtain the QC lot numbers of the prelabeled containers for each sample and enter these on the Sample Identification Matrix Form.
4. Determine the number of shipping containers (coolers) required to accommodate the day's shipment. This is based on the number of samples to be shipped, the number of containers per sample, the number of sample containers that will fit in each cooler, and the number of laboratories to be used. (Note: A group of containers for a single sample should not be split between coolers except when one portion of the sample is to be sent to one laboratory for one type of analysis and the other portion is to be sent to another laboratory for another type of analysis.)
5. Complete an airbill for each laboratory address. (Note: Several coolers may be shipped to the same address under one airbill.) Shipment of medium and high concentration samples requires the use of a special airbill, including a shipper's certification for restricted articles (see Appendix Section B.11.4).

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6. Enter the airbill numbers on the Sample Identification Matrix Form.
7. Mentally assign a chain-of-custody record to each cooler and determine which sample containers will be shipped in each. (Note: More than one chain-of-custody record may be needed to accommodate the number of samples to be shipped in one cooler.)
8. Assign chain-of-custody numbers to each sample by entering these numbers on the matrix. (Reminder: Portions of samples for organic and inorganic analysis will usually be sent to separate laboratories. Use one line on the matrix for the organics portion information and another line for the inorganics portion information.)
9. If the samples are being shipped under a routine analytical service (RAS) determine the number of organic and/or inorganic traffic reports that will be needed. If the samples are high concentration, determine the number of high hazard traffic reports that will be needed.
10. Assign traffic report numbers to each sample and enter these numbers on the matrix.
11. Assign tag numbers to each sample container for each sample and enter these numbers on the matrix.
12. Complete traffic reports, or Special Analytical Services (SAS), packing lists based on the information provided on the Sample Identification Matrix Form.
13. Complete sample tags based on the information provided on the Sample Identification Matrix Form and the parameters of analysis. Place tags in groups by sample number.
14. Complete chain-of-custody records based on the information provided on the Sample Identification Matrix Form.
15. Assign two custody seals to each cooler. Enter the serial numbers of the seals in the "REMARKS" section of each chain-of-custody form and temporarily clip seals to the form.
16. Group all the paper work associated with each cooler in a separate clip.
17. Obtain full signatures of the Sampling Team Leader and initials of significant field team members (including yourself) on the sample tags and at the top of the chain-of-custody forms.

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18. Prepare to package samples for shipment.

Following are step-by-step instructions for completing each form. The sample identification code to be used is the sample number as described in Section 8.7. The project number to be used is W67201.00. Other items should be self-evident from the instructions.

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B.10.2 Sample Identification Matrix (Figure B.1):

Fill out one Sample Identification Matrix Form for each cooler shipped.

1. Indicate RI Project Manager's name.
2. Indicate project number, W67201.00
3. Enter Cherokee County Galena Subsite.
4. Phase I RI.
5. Enter the case number.
6. Enter EPA Region VII sample number.
7. Specify the sample matrix using the two digit codes listed below followed by whether the sample is a grab (G) or composite (C) and whether it is filtered (F) or unfiltered (U).
 - SW - Surface Water
 - GW - Groundwater (Domestic Well)
 - SL - Soil
 - SE - Sediment
 - MW - Mine Water
 - AR - Air
 - BI - Biological (Fish) Sample
8. Indicate the sample code (see bottom of figure).
9. Indicate the analysis code as per CLP/SAS or other requested. Specify codes used from table in lower right hand corner of form.
10. Enter the inorganics traffic report number.
11. Indicate the sample tag number.
12. Indicate bottom size and type from table on form.
13. Enter QC bottle lot number.
14. Indicate date/time sampled - month, day, year (no hyphen or slash, e.g., 051284).
15. Enter preservation code from table on form.

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16. Enter laboratory name and telephone number.
17. Make no entry.
18. Indicate carrier, date shipped and airbill number.

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B.10.3 Sample Tag (Figure B.2):

1. Enter the project number.
2. Enter the station number.
3. Enter date of sampling.
4. Enter time of sampling (military time only).
5. Specify "grab" or "composite" sample with an "X".
6. Insert sample number (Section B.7).
7. Obtain signature of sampling team leader.
8. Indicate presence of preservative with an "X".
9. Specify parameters for analysis with an "X".
- 10a. Indicate traffic report type and serial number (e.g., ITR number: MS 1534).
- 10b. Indicate case number (e.g., CASE #: 1234).
11. Leave BLANK (for laboratory use only).
12. Enter any desired analyses not listed on menu provided (e.g., PCB's, ammonia, sulfide, etc.) and mark box with an "X".

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 7
324 East 11th Street
Kansas City, Missouri 64106



Project Code (1) **Station No.** (2) **Month/Day/Year** (3) **Time** (4)

Designation: ☒ **Comp** ☐ **Grab**

Station Location (5) **Tag No.** 5-48246 **Lab Sample No.** (11)

Samplers (Signatures) (7)

ANALYSES

| | | |
|---------------------------|--------|--|
| BOD | Anions | |
| Solids (TSS), (TDS), (SS) | | |
| COD, TOC, Nutrients | | |
| Phenolics | | |
| Mercury | | |
| Metals | | |
| Cyanide | | |
| Oil and Grease | | |
| Organics GC/MS | | |
| Priority Pollutants | | |
| Volatile Organics | | |
| Pesticides | | |
| Mutagenicity | | |
| Bacteriology | | |

Remarks (10a) (10b) (12)

Preservative: Yes ☐ No ☒ (8)

Figure B.2

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B.10.4 Inorganic Traffic Report (Figure B.3):

1. Insert assigned laboratory case number.
2. Insert sample number (Section B.7).
3. Insert EPA region number (e.g., VII).
4. Insert RI Project Manager's name.
5. Insert RI Project Manager's office telephone number (do not use field office telephone number).
6. Insert date sample was taken.
7. Indicate sample description with an "X".
8. Insert corresponding organic traffic report number for the sample (if any).
9. Specify sample concentration with an "X".
10. Indicate sample matrix with an "X".
11. Insert "Federal Express" (or other approved carrier).
12. Indicate date of shipment.
13. Indicate air bill number on which shipment was made.
14. Check required analyses: Tasks 1 and 2 (metals) and/or Task 3 (circle ammonia and/or sulfide and/or cyanide).
15. Insert the phrase "QC lot number:" and indicate the quality control lot number(s) of the container(s).
16. Insert laboratory name and address.
17. Indicate name of laboratory contact.
18. Leave BLANK - for laboratory use only.

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U.S. ENVIRONMENTAL PROTECTION AGENCY HWI Sample Management Office
PO Box 818 Alexandria VA 22303-703 527-2410-FTS 527-2433

INORGANICS TRAFFIC REPORT

Sample Number

MS 1535

| | | | |
|---|--|---|---|
| 1 Case Number: 1 Sample Site Name/Code: 2a 2b | | 2 SAMPLE CONCENTRATION (Check One) <input type="checkbox"/> Low Concentration 9 <input type="checkbox"/> Medium Concentration 3 SAMPLE MATRIX (Check One) <input type="checkbox"/> Water <input type="checkbox"/> Soil/Sediment 10 | 4 Ship To: 16 Attn: 17 Transfer Ship To: 18 |
| 5 Sampling Office: 3 Sampling Personnel: (Name) 4 (Phone) 5 Sampling Date: 6 (Begin) (End) | | 6 Shipping Information: Name Of Carrier: 11 Date Shipped: 12 Airbill Number: 13 | |
| 7 Sample Description: (Check One) <input type="checkbox"/> Surface Water <input type="checkbox"/> Ground Water 7 <input type="checkbox"/> Leachate <input type="checkbox"/> Mixed Media <input type="checkbox"/> Solids <input type="checkbox"/> Other (specify) 8 MATCHES ORGANIC SAMPLE NO. 15 | | 8 Mark Volume Level On Sample Bottle Check Analysis required <input type="checkbox"/> Task 1 & 2 14 <input type="checkbox"/> Task 3 Ammonia Sulfide Cyanide | |
| MS 1535 - Task 1 & 2 | | | |
| MS 1535 - Task 1 & 2 | | | |
| MS 1535 - Task 3 | | | |
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| MS 1535 - Task 3 | | | |

SMO COPY

Figure B.3

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B.10.5 SAS Packing List (Figure B.4):

1. Insert assigned SAS case number.
2. Insert EPA region number (e.g., VII).
3. Insert RI Project Manager's name.
4. Insert RI Project Manager's office telephone number (do not use field office telephone number).
5. Insert date sample was taken.
6. Indicate date of shipment.
7. Insert site name.
8. Insert laboratory name and address.
9. Indicate name of laboratory contact.
10. List sample numbers.
11. Specify sample type, concentration, tag number, and analysis to be performed (e.g. low concentration soil sample for PCB analysis, tag number 5-48246).
12. Leave BLANK - for laboratory use only.

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U.S. ENVIRONMENTAL PROTECTION AGENCY
CLP Sample Management Office
P.O. Box 818 - Alexandria, Virginia 22313
Phone: 703/557-2490 - FTS/557-2490

SAS Number

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SPECIAL ANALYTICAL SERVICE
PACKING LIST

| | | | |
|---------------------|---------------------|------------|---------------------|
| Sampling Office: 2 | Sampling Date(s): 5 | Ship To: 8 | For Lab Use Only |
| Sampling Contact: 3 | Date Shipped: 6 | | Date Samples Rec'd: |
| (name) | Site Name/Code: 7 | Attn: 9 | Received By: |
| 4 | | | |
| (phone) | | | |

| Sample Numbers | Sample Description Le., Analysis, Matrix, Concentration | Sample Condition on Receipt at Lab |
|----------------|--|---------------------------------------|
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |
| 5. | | |
| 6. | | |
| 7. | | |
| 8. | | |
| 9. | | |
| 10. | | |
| 11. | | |
| 12. | | |
| 13. | | |
| 14. | | |
| 15. | | |
| 16. | | |
| 17. | | |
| 18. | | |
| 19. | | |
| 20. | | |
| | | For Lab Use Only |

White - SMO Copy, Yellow - Region Copy, Pink - Lab Copy for return to SMO, Gold - Lab Copy

Figure B.4

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B.10.6 Chain-of-Custody (Figure B.5):

1. Enter RI Project Manager's name.
2. Enter Cherokee County Galena.
3. Enter date of shipment.
4. Indicate descriptions of shipment.
5. Enter sample numbers in shipment.
6. Enter number and type of containers.
7. Signature of Field Team Leader and whether samples were sealed or unsealed with custody seals.
8. Signature of RI Project Manager and whether samples were sealed or unsealed with custody seals.
9. Indicate reason for change of custody.

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Revision No. 1
Date: 7/22/85
Page B29 of B56

7-EPA-9262(Revised 5-85)

FIGURE B.5

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B.10.7 EPA Region VII Field Sheet (Figure B.6):

1. Survey No. - this number, if available, is obtained from the laboratory.
2. Survey Leader - the person responsible for the sampling effort.
3. Storet No. - a 5 digit number describing the sampling conducted in a particular geographical location.
4. Description - the location of the sampling effort, including address, city and state.
5. Collection date - the date the sample was collected.
6. Time - the time the sample was collected. Use military time.
7. Sampler Name Code - if available, use the survey leader's code.
8. Lab No. - the number assigned by the lab to identify the sample. This number should also appear on the sample tag.
9. Sample Container - identify the container the sample is stored in. This is usually done by volume (i.e. 1 pint, 1 gallon, etc.) and color.
10. Tag Color - describe the color of the tag. The tag color indicates what analysis is to be performed.
11. Preservative - if applicable, identify the chemical used as a preservative.
12. Laboratory - indicate where the sample will be analyzed.
13. Analysis - identify what the sample is to be analyzed for. The tag color should correspond with the type of analysis.
14. Contact - unless otherwise specified, this person is usually the survey leader.
15. Sample Split - indicate if duplicate samples will be given to the owner, operator or person in charge for separate analysis.
16. Remarks - if an SMO number was given to the sample, indicate the number here. This section could also include additional description information about the sample location.

SECTION NO. 0.10
Revision No. 1
Date: 7/22/85
Page B31 of B56

FIELD SHEET
ENVIRONMENTAL PROTECTION AGENCY - REGION VII
SURVEILLANCE AND ANALYSIS DIVISION, 25 FUNSTON ROAD, KANSAS CITY, KANSAS 65115

STATION IDENTIFICATION

SURVEY NO. 1 SURVEY LEADER 2 STORET NO. 3
DESCRIPTION 4

GRAB SAMPLE DATA

| | | | | | | | |
|--------------------------------------|----------------------|----|----|------------|--------------|-------|-------|
| FLOW | TEMP °C | PH | DO | FECAL COLI | OIL & GREASE | OTHER | OTHER |
| <input type="checkbox"/> 00050 (OPM) | AM 00010 WATER 00010 | | | | | | |
| <input type="checkbox"/> 00001 (CFS) | | | | | | | |

| | | | | | | |
|-------------------|----|----|-----|--------|---------------------|-----------|
| COLLECTION DATE 5 | YE | MO | DAY | TIME 6 | SAMPLER NAME CODE 7 | LAB NO. 8 |
| | | | | | | |

| | | | | | | |
|-----------------|----|----|-----|------|-------------------|---------|
| COLLECTION DATE | YE | MO | DAY | TIME | SAMPLER NAME CODE | LAB NO. |
| | | | | | | |

| | | | | | | |
|-----------------|----|----|-----|------|-------------------|---------|
| COLLECTION DATE | YE | MO | DAY | TIME | SAMPLER NAME CODE | LAB NO. |
| | | | | | | |

| | | | | | | |
|-----------------|----|----|-----|------|-------------------|---------|
| COLLECTION DATE | YE | MO | DAY | TIME | SAMPLER NAME CODE | LAB NO. |
| | | | | | | |

COMPOSITE SAMPLE DATA

| | | | | | |
|------------|-------|---------------------------------------|-------------------|------|----------------|
| BEGIN DATE | YE | MO | DAY | TIME | LAB NO. |
| | | | | | |
| END DATE | YE | MO | DAY | TIME | EQUIPMENT CODE |
| | | | | | |
| FLOW RATE | MGD | 1000 L OF GAL DURING COMPOSITE PERIOD | SAMPLER NAME CODE | | |
| 00010 | 00010 | | | | |

WATER CHEMISTRY

| | | | | |
|--------------------|--------------|-----------------|--------------------------------|----------|
| SAMPLE CONTAINER 9 | TAG COLOR 10 | PRESERVATIVE 11 | LABORATORY MOBILE 12 REGION 13 | ANALYSES |
| | | | | |
| | | | | |
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CONTACT 14

SAMPLE ☐ YES 15
SPLIT ☐ NO

REMARKS 16

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B.10.8 Receipt for Samples Form

A completed Receipt for Samples Form will be used whenever splits are provided to other parties. This form must be completed and a copy given to the other party. The original will be retained in the project files. At potential source sites, splits of all samples collected must be offered to an official at the site. If the splits are declined, the Receipt for Samples Form should be so marked.

B.10.9 Field Log Book

All information pertinent to a field survey or sampling effort will be recorded in a log book or project specific serially numbered forms. Each page/form will be consecutively numbered and will be at least 4-1/2 in. by 7 in. in size. All entries will be made in indelible ink or hard lead pencil and all corrections will consist of line-out deletions that are initialed and dated. As a minimum, entries in a log book will include the following:

- Purpose of sampling.
- Location, description, and log of photographs of the sampling point.
- Details of the sampling site (for example, the elevation of the casing, casing diameter and depth, integrity of the casing, etc.).
- Name and address of field contact.
- Documentation of procedures for preparation of reagents or supplies which become an integral part of the sample (e.g., filters and absorbing reagents).
- Identification of sampling crew members.
- Type of sample (for example, groundwater, soil, sludge, or waste water).
- Suspected waste composition.
- Number and volume of sample taken.
- Sampling methodology, including distinction between grab and composite samples.

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- Sample preservation.
- Date and time of collection.
- Sample distribution and how transported (for example, name of the laboratory and cartage agent (Federal Express, United Parcel Service)).
- References such as maps of the sampling site.
- Field observations.
- Any field measurements made (for example, pH, flammability, explosivity, and water depth).
- Signature and date by the personnel responsible for observations.
- Decontamination procedures.

Sampling situations vary widely. No general rules can specify the extent of information that must be entered in a log book. However, records will contain sufficient information so that someone can reconstruct the sampling activity without relying on the collector's memory. The RI Project Manager will keep a master list of all field log books assigned to the Sampling Team Leaders. One log book kept by the RI Project Manager will be a master site log of daily activities and will contain the list of field log books assigned to Sampling Team Leaders.

B.10.10 Corrections to Documentation:

Unless prohibited by weather conditions, all original data recorded in Traffic Report Forms, Sample Identification Tags, Chain-of-Custody Records, and Receipt for Sample Forms will be written with waterproof ink. No accountable serialized documents are to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on an accountable document assigned to one individual, that individual shall make corrections by making a line through the error and entering the correct information. The erroneous information should not be obliterated. Any subsequent error discovered on an accountable document should be corrected by the person who made the entry. All corrections must be initialed and dated.

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B.10.11 Laboratory Custody:

Laboratory custody will conform to procedures established for the CLP. These procedures include:

- Designation of a sample custodian.
- Correct completion by the custodian of the chain-of-custody record, sample tag, and laboratory request sheet; including documentation of sample condition upon receipt.
- Laboratory sample tracking and documentation procedures.
- Secure sample storage (of the appropriate environment - refrigerated, dry, etc.).
- Proper data logging and documentation procedures including custody of all original laboratory records.

B.11 PACKING AND SHIPPING PROCEDURES

Sample packaging and shipping procedures are based on U.S. EPA Specifications, as well as Department of Transportation (DOT) regulations (49 CFR 172.101). The procedures vary according to sample concentration and matrix and are designed to provide optimum protection of samples and the public.

Shipping containers must be insulated, durable, and watertight. Samples are to be cushioned within the shipping container with vermiculite packing material (Zonolite). Preformed poly-foam cooler liners are available for shipment of low-concentration samples only.

Following shipment, airbill numbers must be called in to the SMO.

Step-by-step packing instructions are provided below.

B.11.1 Low Concentration Samples:

1. Prepare cooler(s) for shipment.
 - Tape drain(s) shut.
 - Affix "This Side Up" labels on all four sides and "Fragile" labels on at least two sides of each cooler.

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- Place mailing label with laboratory address on top of cooler(s).
 - Fill bottom of cooler(s) with about 3 in. of vermiculite or use preformed poly-foam liner (low concentration only).
 - Place appropriate traffic reports, SAS packing lists, or Regional field sheets and chain-of-custody records with corresponding custody seals on top of each cooler.
2. Arrange decontaminated sample containers in groups by sample number.
 3. Mark volume levels on bottles with a grease pencil.
 4. Secure appropriate sample tags around caps/lids of containers with string or wire.
 5. Secure container caps/lids with strapping tape.
 6. Arrange containers in front of assigned coolers.
 7. Affix appropriate adhesive labels from assigned traffic report to each container. Protect with clear label protection tape.
 8. Seal each container within a separate plastic bag.
 9. Arrange containers in coolers so that they do not touch.
 10. If ice is required to preserve the samples, cubes should be repackaged in double zip-loc bags and placed on and around the containers (especially on VOA vials).
 11. Fill remaining space with vermiculite (or place poly-foam liner cover on top of samples).
 12. Sign chain-of-custody form (or obtain signature) and indicate the time and date it was relinquished to Federal Express, Purolator, or Emery.
 13. Separate copies of forms. Seal proper copies within a large zip-loc bag and tape to inside lid of cooler. Distribute remaining copies as indicated in B.11.3.
 14. Close lid and latch.

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15. Carefully peel custody seals from backings and place intact over lid openings (right front and left back). Cover seals with clear protection tape.
16. Tape cooler shut on both ends, making several complete revolutions with strapping tape (do not cover custody seals). See Figure B.8 for an illustration of a cooler ready for shipment.
17. Relinquish to Federal Express. Place airbill receipt inside the mailing envelope and send to the Regional SMO sample documentation coordinator, along with the other documentation.
18. Telephone the Sample Management Office in Alexandria, Virginia. (NOTE: this step should be omitted for samples sent to labs outside the Contract Laboratory Program).

Ms. Leslie Braun (subject to change)
(703) 557-2490

Provide the following information:

- Your name
- Project name
- Case number
- Number of samples sent to each laboratory for analysis
- Airbill numbers

This must be done immediately following sample shipment. (If the SMO is closed at that time, call in the information first thing the next day.)

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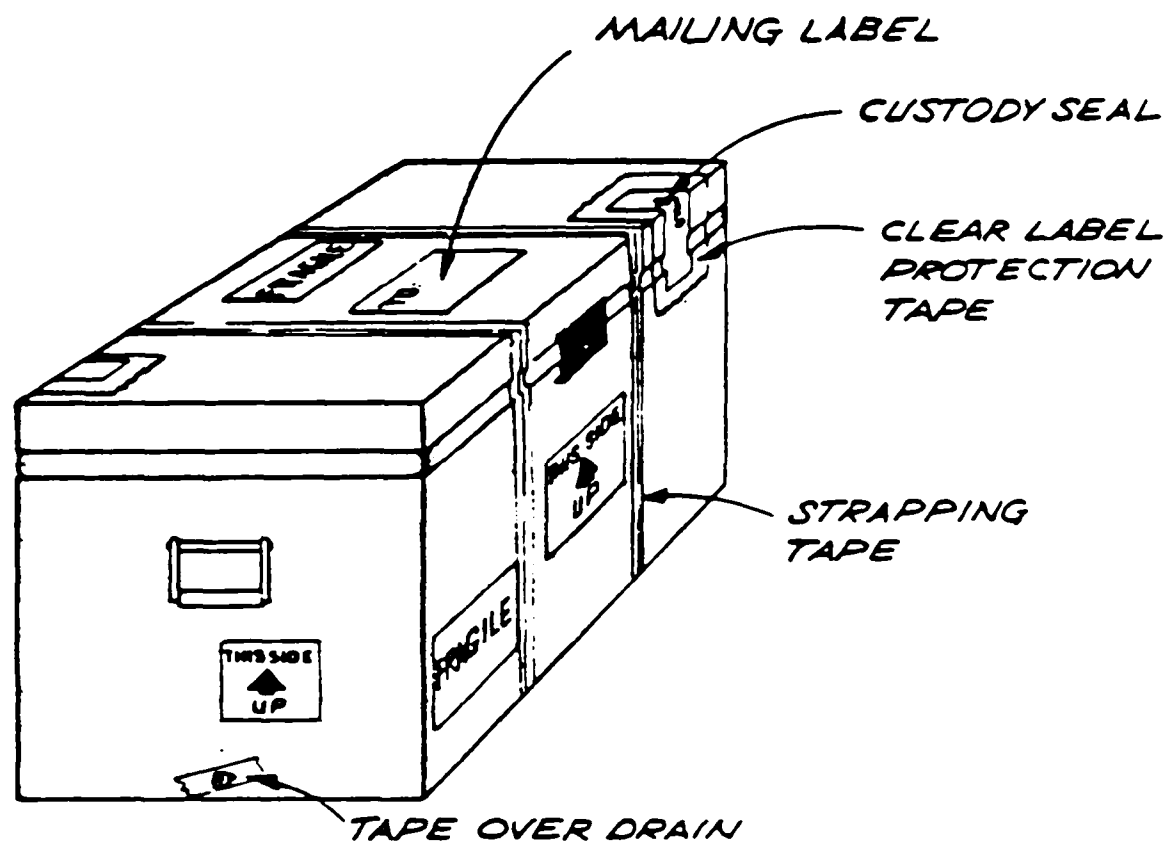


Figure B.7
COOLER READY FOR SHIPMENT

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B.11.2 Medium and High Concentration Samples:

Medium and high concentration samples are packaged using the same techniques used to package low concentration samples, with several additional restrictions. First, a special airbill including a Shipper's Certification for Restricted Articles is required (see Figures B.8 and B.9). Second, "Flammable Liquid N.O.S." or "Flammable Solid N.O.S." labels must be placed on at least two sides of the cooler. Third, sample containers are packaged in metal cans before being placed into the cooler, as indicated below.

- Place approximately one-half inch vermiculite in bottom of can.
- Position jar in zip-loc bag so that sample tags can be read through the plastic.
- Place jar in can and fill remaining volume with vermiculite.
- Close the can and secure the lid with metal clips.
- Write traffic report number on lid.
- Place "This Side Up" and "Flammable Liquid N.O.S." (or "Flammable Solid N.O.S.") labels on can.
- Place cans in cooler.

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B.11.3 Distribution of Completed Documents

Final disposition of completed documents is as follows:

- Shipped with Samples:
Yellow chain-of-custody form, Traffic report forms (lab copy, lab file copy), pink and gold copies SAS packing list, sample tags
- Sent to Sample Management Office:
Traffic report forms, SMO copy (white)
SAS packing list, SMO copy (white)
Chain-of-custody form
Airbill copy
- Sent to EPA Region VII within one week:
Chain-of-custody form, original
Traffic report forms, pink copies
SAS packing list, yellow copy
Original field sheet
Airbill copy

B.11.4 Special Instructions for Shipping Samples via Federal Express

1. Label cooler
 - Write shipper's address on outside of cooler. If address is stenciled on, just write "shipper" above it.
 - Write or affix sticker saying "This Side Up" on two adjacent sides.
 - Write or affix sticker saying "ORM-E" with box around it on two adjacent sides. Below ORM-E, write NA#9188.
 - Label cooler with "Hazardous Substance, NOS.", and "liquid" or "solid", as applicable.
2. Complete the special shipping bill for restricted articles (Figures B-8 and B-9).
 - Under Proper Shipping Name, write "Hazardous Substance, NOS." and "liquid" or "solid", as applicable.

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| | | | | | | |
|---|--|--|--------------------|-----------------------------|--|--|
| AIRBILL NUMBER 350530784 | | SHIPPER'S CERTIFICATION FOR RESTRICTED ARTICLES (TYPE OR PRINT) | | | | |
| NO. OF PKGS. | PROPER SHIPPING NAME (PER 49 CFR 172.101) | CLASSIFICATION | IDENTIFICATION NO. | NET QUANTITY PER PACKAGE | | |
| | | | | | | |
| ADDITIONAL DESCRIPTION REQUIREMENTS FOR RADIOACTIVE MATERIALS (SEE BACK) | | | | | | |
| | | | | | | |
| THIS SHIPMENT IS WITHIN THE LIMITATIONS PRESCRIBED FOR | | | | | | |
| IF ACCEPTABLE FOR PASSENGER AIRCRAFT, THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS OR TREATMENT. | | | | | | |
| I HEREBY CERTIFY THAT THE CONTENTS OF THIS CONSIGNMENT ARE FULLY AND ACCURATELY DESCRIBED ABOVE BY PROPER SHIPPING NAME AND ARE CLASSIFIED, PACKED, MARKED, AND LABELED, AND IN PROPER CONDITION FOR CARRIAGE BY AIR ACCORDING TO APPLICABLE NATIONAL GOVERNMENTAL REGULATIONS. | | | | | | |
| PASSENGER AIRCRAFT CARGO AIRCRAFT ONLY (DELETE NONAPPLICABLE) | | | | | | |

Section No. B.11
 Revision No. 1
 Date: 7/22/85
 Page B41 of 856

Figure B.9

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- Under Class, write "ORM-E."
- Under Identification No. write NA#9188.

B.12 SAMPLING SUMMARY OF LABORATORY REQUIREMENTS

Numbers of samples and bottles are summarized in Table B.4. The columns titled "Field Samples" indicate the number and type of bottles used for each group of sample. The columns titled "Laboratory Samples" indicate how individual sample bottles will be grouped for shipment to the laboratory.

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TABLE B.4
SAMPLING SUMMARY

| Sample Location | Media | Field Samples | | Laboratory Samples | | Laboratory Services |
|-------------------------------|-------|---------------|-----------------------|--------------------|------------------------|---------------------|
| | | No. | Type | No. | Type | Type |
| Short Creek | SW | 7 | 1-1. total metals | 7 | 1-1. metals | CLP |
| | | 7 | 1-1. cyanide | 7 | 1-2. cyanide | CLP |
| | | 7 | 1-1. dissolved metals | 7 | 1-1. metals | CLP |
| | | 7 | 1-1. water chemistry | 7 | 1-1. water chemistry* | SAS |
| | | 3 | 1-gal. radioactivity | 3 | 1-gal. radioactivity** | Non-CLP |
| Misc. Short Creek Tributaries | | 7 | 1-1. total metals | 7 | 1-1. metals | CLP |
| | | 7 | 1-1. cyanide | 7 | 2-2. cyanide | CLP |
| | | 7 | 1-1. dissolved metals | 7 | 1-1. metals | CLP |
| | | 7 | 1-1. water chemistry | 7 | 1-1. water chemistry | SAS |
| Shoal Creek | | 2 | 1-1. total metals | 2 | 1-1. metals plus | CLP |
| | | 2 | 1-1. cyanide | 2 | 1-1. cyanide | CLP |
| | | 2 | 1-1. dissolved metals | 2 | 1-1. metals | CLP |
| | | 2 | 1-1. water chemistry | 2 | 1-1. water chemistry | SAS |
| | | 2 | 1-gal. radioactivity | 2 | 1-gal. radioactivity | Non-CLP |
| Misc. Shoal Creek Tributaries | | 4 | 1-1. total metals | 4 | 1-1. metals plus | CLP |
| | | 4 | 1-1. cyanide | 4 | 1-1. cyanide | CLP |
| | | 4 | 1-1. dissolved metals | 4 | 1-1. metals | CLP |
| | | 4 | 1-1. water chemistry | 4 | 1-1. water chemistry | SAS |
| Spring River | | 2 | 1-1. total metals | 2 | 1-1. metals | CLP |
| | | 2 | 1-1. cyanide | 2 | 1-1. cyanide | CLP |
| | | 2 | 1-1. dissolved metals | 2 | 1-1. metals | CLP |
| | | 2 | 1-1. water chemistry | 2 | 1-1. water chemistry | SAS |
| | | 1 | 1-gal. radioactivity | 1 | 1-gal. radioactivity | Non-CLP |
| Spring River Tributary | | 1 | 1-1. total metals | 1 | 1-1. metals | CLP |
| | | 1 | 1-1. cyanide | 1 | 1-1. cyanide | CLP |
| | | 1 | 1-1. dissolved metals | 1 | 1-1. metals | CLP |
| | | 1 | 1-1. water chemistry | 1 | 1-1. water chemistry | SAS |
| Empire Lake | | 3-6 | 1-1. total metals | 3-6 | 1-1. metals | CLP |
| | | 3-6 | 1-1. cyanide | 3-6 | 1-1. cyanide | CLP |
| | | 3-6 | 1-1. dissolved metals | 3-6 | 1-1. metals | CLP |
| | | 3-6 | 1-1. water chemistry | 3-6 | 1-1. water chemistry | SAS |
| Misc. Subsidence Depressions | | 3 | 1-1. total metals | 3 | 1-1. metals | CLP |
| | | 3 | 1-1. cyanide | 3 | 1-1. cyanide | CLP |
| | | 3 | 1-1. dissolved metals | 3 | 1-1. metals | CLP |
| | | 3 | 1-1. water chemistry | 3 | 1-1. water chemistry | SAS |

*Water chemistry includes total alkalinity, total acidity, sulfate, and total dissolved solids
**Radioactivity includes gross alpha, gross beta, and radium

Table B.4
Page 2
Sampling Summary

| Sample Location | Media | Field Samples | | Laboratory Samples | | Laboratory Services Type |
|---|-------|---------------|------------------------|--------------------|--------------------------|--------------------------|
| | | No. | Type | No. | Type | |
| Optional Samples | SW | 3 | 1-l. total metals | 3 | 1-l. metals | QLP |
| | | 3 | 1-l. cyanide | 3 | 1-l. cyanide | QLP |
| | | 3 | 1-l. dissolved metals | 3 | 1-l. metals | QLP |
| | | 3 | 1-l. water chemistry | 3 | 1-l. water chemistry* | SAS |
| Duplicate Samples | SW | 2 | 1-l. total metals | 2 | 1-l. metals | QLP |
| | | 2 | 1-l. cyanide | 2 | 1-l. cyanide | QLP |
| | | 2 | 1-l. dissolved metals | 2 | 1-l. metals | QLP |
| | | 2 | 1-l. water chemistry | 2 | 1-l. water chemistry | SAS |
| | | 1 | 1-gal. radioactivity | 1 | 1-gal. radioactivity | Non-QLP |
| Field Blanks (3 samples) and Audits (2 samples) | SW | 4 | 1-l. total metals | 4 | 1-l. metals | QLP |
| | | 4 | 1-l. cyanide | 4 | 1-l. cyanide | QLP |
| | | 4 | 1-l. dissolved metals | 4 | 1-l. metals | QLP |
| | | 4 | 1-l. water chemistry | 4 | 1-l. water chemistry | SAS |
| | | 1 | 1-gal. radioactivity | 1 | 1-gal. radioactivity | Non-QLP |
| Misc. Wells | GW | 21 | 1-l. total metals | 21 | 1-l. metals | QLP |
| | | 21 | 1-l. cyanide | 21 | 1-l. cyanide | QLP |
| | | 21 | 1-l. dissolved metals | 21 | 1-l. metals | QLP |
| | | 21 | 1-l. water chemistry | 21 | 1-l. water chemistry | |
| Misc. Mine Shafts | MW | 17 | 1-l. total metals | 17 | 1-l. metals | QLP |
| | | 17 | 1-l. cyanide | 17 | 1-l. cyanide | QLP |
| | | 17 | 1-l. dissolved metals | 17 | 1-l. metals | QLP |
| | | 17 | 1-l. water chemistry | 17 | 1-l. water chemistry | SAS |
| Duplicate Samples | MW/GW | 2 | 1-l. total metals | 2 | 1-l. metals | QLP |
| | | 2 | 1-l. cyanide | 2 | 1-l. cyanide | QLP |
| | | 2 | 1-l. dissolved metals | 2 | 1-l. metals | QLP |
| | | 2 | 1-l. water chemistry | 2 | 1-l. water chemistry | SAS |
| Field Blanks (2 samples) and Audits (2 samples) | | 4 | 1-l. total metals | 4 | 1-l. metals | QLP |
| | | 4 | 1-l. cyanide | 4 | 1-l. cyanide | QLP |
| | | 4 | 1-l. dissolved metals | 4 | 1-l. metals | QLP |
| | | 4 | 1-l. water chemistry | 4 | 1-l. water chemistry | SAS |
| 8 Soil Sampling Grids | SL | 16 | 8-oz. metals & cyanide | 16 | 8-oz. metals and cyanide | QLP |
| | | | | | | |
| Duplicate Samples | SL | 2 | 8-oz. metals & cyanide | 2 | 8-oz. metals and cyanide | QLP |
| Audit Sample | SL | 1 | 8-oz. metals & cyanide | 1 | 8-oz. metals and cyanide | QLP |

*Water chemistry includes total alkalinity, total acidity, sulfate, and total dissolved solids
 **Radioactivity includes gross alpha, gross beta, and radium

| Sample Location | Media | Field Samples | | Laboratory Samples | | Laboratory Services Type |
|---|-------|---------------|--|--------------------|----------------------------|--------------------------|
| | | No. | Type | No. | Type | |
| Empire Lake Fish | BI | 4 | 1-qt. plastic bags | 2 | 2-qt. metals and cyanide | Non-CLP |
| Duplicate Samples | BI | 2 | 1-qt. plastic bags | 1 | 2-qt. metals and cyanide | Non-CLP |
| | | | | | | |
| Mine waste sources, upwind control, and two populated areas | AR | 8 to 18 | 8-oz. bulk material for XRD and XRF | 8-18 | X-ray Diffraction | non-CLP |
| | | | | 8-18 | X-ray Fluorescence | non-CLP |
| Airborne Particulate Samples | AR | 112 | Airborne particulate samples on Teflon filters | 112 | XRF Fingerprint | non-CLP |
| | | | | 40 | XRD Fingerprint and Metals | non-CLP |
| | | | | 24 | Asbestos*** | CLP |
| Duplicate Airborne Particulate Samples | AR | 14 | Teflon Filters | 14 | XRF Metals | non-CLP |
| | | | | 5 | XRD Metals | non-CLP |
| | | | | 3 | Asbestos | CLP |
| Field Blanks | AR | 8 | Teflon Filters | 8 | XRF Metals | non-CLP |
| | | | | 4 | XRD Metals | non-CLP |
| | | | | 2 | Asbestos | CLP |
| | | | | | | |
| Short Creek | SD | 1 | 8-oz. metals and cyanide | 1 | 8-oz. metals plus cyanide | CLP |
| | | 3 | 1-l glass jar radioactivity | 3 | 1-l radioactivity | Non-CLP |
| Shaul Creek | SD | 1 | 8-oz. metals and cyanide | 1 | 8-oz. metals plus cyanide | CLP |
| | | 2 | 1-l glass jars | 2 | 1-l radioactivity | Non-CLP |
| Spring River | SD | 1 | 8-oz. metals and cyanide | 1 | 8-oz. metals plus cyanide | CLP |
| | | 1 | 1-l radioactivity | 1 | 1-l radioactivity | Non-CLP |
| Empire Lake (3 samples) | SD | 3 | 8-oz. metals and cyanide | 3 | 8-oz. metals plus cyanide | CLP |
| Audit (1 sample) | | 1 | 8-oz. metals | 1 | 8-oz. metals | CLP |
| Duplicate Samples (2) | SD | 1 | 8-oz. metals and cyanide | 1 | 8-oz. metals plus cyanide | CLP |
| | | 1 | 1-l radioactivity | 1 | 1-l radioactivity | Non-CLP |

*Water chemistry includes total alkalinity, total acidity, sulfate, and total dissolved solids.

**Radioactivity includes gross alpha, gross beta, and radium.

***At least 12 of these samples will be analyzed by both phase contrast and electron microscopy.

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B.13 EQUIPMENT CALIBRATION, OPERATION, AND MAINTENANCE

B.13.1 Introduction

This section contains standard operating procedures for use and care of equipment used during REM/FIT activities. Items of equipment described in this section are those that require continual attention. They are described along with their calibration, field checking, operations, and maintenance procedures to the extent that is necessary for proper care of each item.

B.13.2 Policies of QA Program as Applied to Equipment

The QA Program has been developed in accordance with the manufacturers' maintenance and calibration guidelines and the specific requirements of the REM/FIT program.

All equipment calibration, operation and maintenance, and field checking procedures defined will be performed by REM/FIT personnel who have been properly trained in these procedures.

All equipment on loan from EPA, or obtained through leasing agencies will undergo similar calibration, maintenance, and field checks as defined for REM/FIT equipment.

All personnel using this equipment will adhere to the requirements of the program.

Only designated or certified personnel can calibrate, operate, and maintain certain instruments.

The calibration and field check schedule defined in this program is considered minimal; a more frequent schedule can be maintained by the region or instrument operator if deemed necessary.

The records management system within a region should be sufficient to track the calibration, operation, and maintenance history of a given instrument or piece of equipment for use as evidence and for quality control purposes.

B.13.3 Calibration and Field Check Frequencies

Table B.3 outlines the calibration and field check schedules for all equipment described in this section.

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B.13.4 Solar Electronics Radiation Alert Mini-Meter

Description: The radiation alert-mini meter is a miniature ionizing radiation detector with adjustable audible alarms and led level indicators. It is carried in a pocket or clipped on a belt. The meter gives immediate warning when approaching a radioactive source, or when the ambient radiation level is rising. It detects alpha, beta, gamma, and X-rays and uses a single 9-volt alkaline battery with a battery life up to 2,000 hours.

Calibration: It is not necessary to calibrate before use because the radiation meter is calibrated at the factory to a particular isotope.

Every Year: The radiation meter should be factory calibrated. The Regional Equipment Coordinator sends it to Solar Electronics, 156 Drakes lane, Summertown, Tennessee 38483.

Operation: Any REM/FIT-trained personnel may operate this meter.

With the meter on, each incoming geiger count will be heard as a beep or click. In addition, the yellow count light will display incoming counts. This meter is equipped with an audio alarm, which will be heard in both the "on" and "audio" modes at higher radiation levels.

Ranges:

X1 - The left alarm light indicates at least 0.1 mR/hr, and the right alarm light indicates 0.3 mR/hr, which is 10 to 30 times background. The audio alarm will sound every 45 seconds above 0.1 mR/hr in the X1 range.

X10 - The two alarm lights indicate 1 to 3 mR/hr, respectively, or 100 to 300 times background. A tone will sound above 1 mR/hr.

X100 - The two alarm lights indicate 10 to 30 mR/hr, respectively, or 1,000 to 3,000 times natural background. The audio alarm will sound above 10 mR/hr.

If both the alarm lights are lit in one of the lower ranges, change to the next higher range.

• •

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TABLE B.3
FREQUENCIES FOR CALIBRATIONS AND FIELD CHECKS

| Item | Regular Calibration Required* | Field Check Daily** | Field Calibration Before Each Use** |
|-----------------------------------|----------------------------------|------------------------|--|
| Air Sampler | At Start of Project | X | |
| Electric Water-Level Indicator | At Start of Project | X | |
| Flow Meter | Factory Calibrated | X | |
| Meteorological Station | Factory Calibrated | X | |
| pH Meter | Semi-Annual | X | X |
| Pipe Dredge | None Required | | |
| Point-Source Bailer | None Required | | |
| Radiation Alert Meter | Yearly | X | |
| Specific Conductivity Meter | Semi-Annual | X | X |
| Specific-Depth Sampler | None Required | | |
| Survey Equipment | Semi-Annual | | |
| Tape Measure | None Required | | |
| Thermometer | None Required | | |

*To be performed by designated instrument repairman. Records of these calibrations are kept on file for the life of the instrument.

**These are to be performed by the field team and documented in field log book.

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Maintenance: Before Each Use: Check battery and alarm function.

Daily Field Check: Field check meter daily using a low level radiation source (such as a Coleman Lantern mantle).

B.13.5 pH Meter

Description: This instrument is used to measure the hydrogen ion concentration in aqueous solutions.

Calibration: Calibration of the pH meter will be done on a daily basis as follows:

1. Rinse electrode in distilled water and blot dry.
2. Determine solution temperature and set temperature compensator to the proper reading.
3. Place electrode in a commercial buffer solution with a pH of approximately 2 (expected lower range) and adjust calibration knob until readout displays the proper pH value.
4. Remove probe from solution, rinse with distilled water, and blot dry.
5. Place the probe in a second commercial buffer solution with a pH of 10 (expected upper range) and adjust slope control until the meter reads the pH value of the buffer solution.
6. Remove probe from solution, rinse with distilled water, and blot dry.
7. Place probe in a third commercial buffer with a pH of approximately 7 and record value.
8. If the measured value varies from the expected value by greater than .2 pH units, recalibrate the instrument with fresh aliquots of buffer solution. If the discrepancy persists, begin troubleshooting the instrument as prescribed in the operating instructions.

Records of all calibrations will be kept on file

Operation: The pH meter may be operated using the following procedures:

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1. Rinse a small beaker with distilled water three times.
2. Rinse pH probe with sample water.
3. Determine sample temperature and adjust the pH meter temperature compensator.
4. Place probe in sample and gently swirl, keep probe in the sample until reading stabilizes.
5. Record sample pH and temperature and note any problems such as meter drift.

Maintenance: The following steps will be taken to insure proper operation of the pH meter:

1. Check batteries each time the meter is used.
2. Keep the probe stored in distilled water at all times when the meter is not in use.
3. Inspect the glass electrode on a daily basis for cracks or scratches.

B.13.6 Electrical (Specific) Conductivity Meter

Description: This instrument is used to measure the electrical conductance of aqueous solutions. The specific conductance of a solution provides an indirect estimate of total dissolved solids.

Calibration: The specific conductivity meter may be calibrated through the determination of the cell constant at the end of each day of sampling. This involves:

1. Thoroughly rinsing the probe with 0.0100 normal KCl solution.
2. Measure the specific conductance of fresh 0.0100 normal KCl solution.
3. Determine the temperature of the KCl solution.
4. Determine the cell constant. The cell constant is the ratio of computed electrical conductivity to the measured conductivity of the KCl sample. This constant and sample temperatures are used to adjust all measurements made in a given day to standard conditions.

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Records of all calibrations will be kept on file.

Operation: The specific conductivity meter may be operated as follows:

1. Thoroughly rinse the probe and sample beaker with sample water.
2. Measure the temperature of the sample water.
3. Place the probe in the sample beaker with sufficient sample to completely submerge the probe. Swirl probe in sample to remove any air bubbles.
4. Select the highest multiplier scale on the meter and turn the instrument on. Progressively use lower multiplier scales until a mid-scale deflection is obtained.
5. Record temperature and conductivity values.
6. Specific conductivity values are corrected for temperature using:

$$K_{25^{\circ}\text{C}} = \frac{K \text{ measured}}{1 + 0.0191 (t - 25)}$$

Where:

K = Conductivity umohs/cm
t = temperature °C

Specific conductivity values are corrected for the cell constant using:

$$\text{Conductivity} = \frac{1413}{K_{\text{KCl}}} \times K \text{ sample}$$

Maintenance: The following steps will be taken to insure proper operation of the conductivity meter:

1. Check batteries each time the instrument is used.
2. Keep the probe stored in distilled water at all times when the meter is not in use.
3. Inspect the probe on a daily basis for damage or loss of platinum black plating from the electrode. If the plating is damaged, replatinize the probe as prescribed in the operator's manual.

B.13.7 Electric Water-Level Indicator

Description: This instrument is used to determine the distance between a given measuring point and an underlying water surface.

Calibration: Before each monitoring round, all distance markers on the electric well sounder will be checked with a steel tape. Any markers which are improperly located will be moved to the correct position and secured. After each monitoring round, the distance marks will be checked again to see if any slipped during gauging of the wells. If any marks slipped, all measurements which could be in error will be remeasured. All calibrations will be documented and kept on file.

Operation: Soundings of wells may be obtained by lowering the probe into a well until the indicator light or buzzer show that the probe is in water. The depth to water will be measured from a point of known elevation such as the top of casing.

Maintenance: Prior to each monitoring round, the batteries will be checked and the well sounder will be inspected for any damage which would affect measurements.

B.13.8 Kemmerer or Van Dorn Specific-Depth Samplers

Description: These samplers consist of a metal or plastic tube several inches in diameter with two retractable rubber end caps which can be closed to capture a water sample from a specific zone. A small pipe "messenger" is dropped around the rope to trigger closing of the end caps.

Calibration: None

Operation: the sampler is operated as follows:

1. Retract and fasten the end caps.
2. Lower the sampler to the proper depth with a rope, being careful not to drop the messenger behind the sampler.
3. Drop the messenger around the rope to close the sampler.
4. Withdraw the sampler.

Maintenance: Normal care in handling, inspect rope regularly.

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B.13.9 Point-Source Bailer

Description: The point-source bailer is a PVC tube with a one-way valve at either end, and allow for collection of a sample from a specific depth.

Calibration: None

Operation: Lower the sampler to the proper depth, then withdraw it.

Maintenance: Normal care in handling. Inspect rope regularly.

B.13.10 Pipe Dredge

A pipe dredge is a simple sediment-sampling device consisting of a short length of pipe with a vented cap on one end.

Calibration: None

Operation: With a rope tied securely to the dredge, throw it into the surface water body and drag it back to shore

Maintenance: Normal care in handling.

B.13.11 Climatronics Electronic Weather Station (EWS)

A Climatronics Electronic Weather Station (EWS) will be operated at the site, with data being continuously recorded by strip chart recorder and by a Campbell Scientific CR21 micrologger. The micrologger records vector winds (which includes average wind speed, average wind vector magnitude, average wind vector direction, and standard deviation of wind direction), average temperature (T), and average relative humidity (RH) hourly on the hour. Rainfall is measured by a pulsed accumulator sensor that records bucket tips (events) on the strip chart recorder, but is not recorded by the micrologger.

Procedures for Operating the Electronic Weather Station: The EWS can be operated with two 6-volt DC lantern batteries or with AC power. As long as good, reliable AC power is available, it will be operated with AC power.

As long as the data logger is in use, the wind speed range should be in the 0-100 mph position. If it is changed to the 0-50 mph range, the data logger must be reprogrammed. The temperature should be kept in the 20-120° F scale throughout Phase I. For Phase II site investigations, the temperature setting may have to be changed.

If the temperature goes below 20°F during the day and stays below 60°F during the day, the temperature switch should be placed in the -40 to 60°F position and the data logger will be reprogrammed.

Strip charts will be replaced once a month, or sooner if the red color marker appears on the strip chart. The removed strip chart should be dated and identified with the sampling location and sampler number. The strip charts will be sent to the Project Air Quality Specialist.

The data logger is operated by 8 D-cell batteries. Enter *6A to check battery voltage. If voltage is below 10V, the batteries should be replaced. This can be accomplished by turning off the data logger, replacing the batteries, and reprogramming the data logger. Or, a 12 volt car battery can be connected to the data logger to maintain a constant power source (see manufacturer's operation manual) while the D-cell batteries are replaced. Reprogramming should then not be required.

The Campbell Scientific CR21 data logger will be programmed according to a site-specific field operations manual that will be prepared by the project Air Quality Specialist. Following this manual, the field technician can obtain a readout of wind speed and direction, temperature and relative humidity each time he checks the weather station, to compare the readings to the current weather conditions. The field technician can also perform other field tests to make sure the instruments are operating properly.

B.13.12 Temperature Measurement

Description: Field temperature measurements will be made using a mercury thermometer.

Calibration: None required.

Operation: Rinse the thermometer with distilled water. Insert thermometer into sample and leave it in the sample until the temperature reading stabilizes. Record the reading and rinse the thermometer with distilled water.

Maintenance: Handle carefully and transport in a secure container, as thermometers are easily broken.

Section No. B.13
Revision No. 1
Date: 7/22/85
Page B55 of B56

B.13.13 Radon and Radon Daughter Procedure

PROCEDURE FOR ACQUISITION AND EVALUATION OF SHORT-TERM RADON AND RADON DAUGHTER SAMPLES

Purpose and Principles of Operation

Short-term or "grab" samples are used to determine the concentrations of radon (Rn-222) gas and radon daughter products in ambient air at a single point in time. By appropriately controlling the environment in which the samples are taken, these instantaneous results are often used to estimate long-term averages, though that is beyond the scope of this procedure. The following describes the acquisition and evaluation of grab samples of radon and/or radon daughters in ambient air using the monitoring kit assembled by ORP-LVF. The contents of the kit are listed in Appendix A.

Grab sampling for radon and/or radon daughters basically involves the acquisition of a measured volume of air. While the two quantities are measured separately, both types of samples may be acquired simultaneously for convenience. For the radon daughter sample, a measured volume of air is drawn through a membrane filter (Millipore type HA, 0.45-micron pore size, or equivalent). An air pump capable of drawing from 1 to 10 liters per minute is used for the sampling. The filter is subsequently evaluated by alpha scintillation counting the radioactive decay of the particulate radon daughters. In this procedure the Kusnetz Technique (ANSI73) is preferred, but other techniques such as those developed by Tsvoglou (Th70, 71), or Rolle (Ro72) can also be used. In the Kusnetz technique, the filter is counted at any time during a period from 40 to 90 minutes after sampling. The radon daughter concentration, expressed in units of working level (WL), can be calculated from the count rate, the system counting efficiency, the air sampling rate and duration of sampling, and a correction factor for the delay time between the end of the sampling period and the mid-point of the counting period.

The concentration of radon gas is determined using an alpha scintillation cell, similar to the design of Lucas (Lu57), into which a known volume of filtered air is drawn. After a waiting period of at least 4 hours, during which the radon daughters grow into secular-equilibrium with the radon, the cell is evaluated by counting the alpha scintillation events. The radon concentration is calculated from the count rate, the predetermined system counting efficiency, the cell volume, and the correction factor for radioactive decay between the times of sampling and counting.

There are four distinct, sequential tasks used to obtain simultaneous "grab" samples of radon gas and its particulate daughters. First, the counting system is standardized by making background counts, followed by counts of the standard alpha scintillation cell (provided with each counting system) and an electroplated disk source of known alpha emission activity. Second, the sample is acquired by connecting the filter holder, scintillation

cell, and air pump in series. Third, the filter is evaluated to determine the radon daughter concentration by the Kusnetz technique. Finally, the alpha scintillation cell is evaluated to determine the radon concentration.

Counting System Checkout Procedures

1. Remove the counting system (EDA Instruments, Inc., model RDA-200) from the carrying case, set it upright on a convenient surface, and turn the main power switch to "INT" (internal battery power). The "LIGHT" warning flag will show red when the instrument is first turned on, but should disappear when sampling is initiated. If it does not disappear, check for light leaks in the counting chamber. Set the "TIME (MIN)" selector to "10" (for a 10-minute count) and depress the "SAMPLE" push-button while observing the "BATT" (battery) warning flag. If the flag shows red, even momentarily, replace the batteries according to instructions in the RDA-200 Operation Manual. Check to see that the "RA-AM" switch is always in the "RA" position.
2. Turn the "POWER" switch to "OFF," open the counting chamber, and remove the standard test cell (normally stored in the chamber when the instrument is not in use). Record the serial number of the cell and the standard count rate in the "Comments" section of the data form (see example, Figure 1). Place the cell into the counting chamber with the window side inward and reclose the counting chamber with the flat chamber cap and threaded ring. Wait at least 2 minutes for any residual light activation to die away, turn the "POWER" switch to "INT," press the "SAMPLE" button, and record the accumulated counts after 10 minutes in the "Comments" section of the data form. Repeat the count, and record. (Note: The red indicator light located beneath the "START" button will blink continuously during the counting period, but will go out when the count is complete. The numeric, 5-digit display will appear when "SAMPLE" is depressed, but the 4 most significant digits will disappear after a few seconds in order to conserve battery life; to read the full display at any time, merely press the "DISPLAY" button).
3. Turn the "POWER" switch to "OFF," open the counting chamber and remove the test cell, and select a scintillator tray from the kit. Remove the black plastic cap from the scintillator tray (if present), carefully place a clean filter paper into the tray (using tweezers to handle the filter), and insert the scintillator tray into the counting chamber. Replace the flat chamber cap and threaded retaining ring, wait at least 2 minutes, and push "START" for a 10-minute background count (this count will be used as the background count for subsequent filter counts for radon daughter measurements). Record the background count in the appropriate block on the data form. Repeat the count, and record.

| | | |
|------------|---------|--------|
| STREET: | | |
| CITY : | COUNTY: | STATE: |
| SURVEYORS: | | |

| | | | | | | | | | | | | | |
|----------|-----------------|-------------|------------|--------------|-------------|-------------|-----------------|---------------------|-------|--------|------------|---------|--------|
| LOCATION | SAMPLE DA/TA | ROTO BEG | RDG END | FLOW RATE | FILTER/TRAY | BKGD COUNTS | BKGD COUNT PRD. | COUNT DATE, TIME | DELAY | COUNTS | COUNT PRD. | RESULTS | Z EQU. |
| | | | | | | | | | min | | WL: | | |
| | | | | | | | | | hrs 1 | | pCi/l: | | |
| | | | | | | | | | hrs 2 | | | | |
| | | | hrs 3 | | | | | | | | | | |

| | | | | | | | | | | | | | |
|----------|-----------------|-------------|------------|--------------|-------------|-------------|-----------------|---------------------|-------|--------|------------|---------|--------|
| LOCATION | SAMPLE DA/TA | ROTO BEG | RDG END | FLOW RATE | FILTER/TRAY | BKGD COUNTS | BKGD COUNT PRD. | COUNT DATE, TIME | DELAY | COUNTS | COUNT PRD. | RESULTS | Z EQU. |
| | | | | | | | | | min | | WL: | | |
| | | | | | | | | | hrs 1 | | pCi/l: | | |
| | | | | | | | | | hrs 2 | | | | |
| | | | hrs 3 | | | | | | | | | | |

| | | | | | | | | | | | | | |
|----------|-----------------|-------------|------------|--------------|-------------|-------------|-----------------|---------------------|-------|--------|------------|---------|--------|
| LOCATION | SAMPLE DA/TA | ROTO BEG | RDG END | FLOW RATE | FILTER/TRAY | BKGD COUNTS | BKGD COUNT PRD. | COUNT DATE, TIME | DELAY | COUNTS | COUNT PRD. | RESULTS | Z EQU. |
| | | | | | | | | | min | | WL: | | |
| | | | | | | | | | hrs 1 | | pCi/l: | | |
| | | | | | | | | | hrs 2 | | | | |
| | | | hrs 3 | | | | | | | | | | |

| | | | | | | | | | | | | | |
|----------|-----------------|-------------|------------|--------------|-------------|-------------|-----------------|---------------------|-------|--------|------------|---------|--------|
| LOCATION | SAMPLE DA/TA | ROTO BEG | RDG END | FLOW RATE | FILTER TRAY | BKGD COUNTS | BKGD COUNT PRD. | COUNT DATE, TIME | DELAY | COUNTS | COUNT PRD. | RESULTS | Z EQU. |
| | | | | | | | | | min | | WL: | | |
| | | | | | | | | | hrs 1 | | pCi/l: | | |
| | | | | | | | | | hrs 2 | | | | |
| | | | hrs 3 | | | | | | | | | | |

FIGURE 1. SAMPLE
DATA FORM

RADON DECAY FACTOR

| Hours | Factor |
|-------|--------|
| 4 | 0.9702 |
| 5 | 0.9629 |
| 6 | 0.9557 |
| 7 | 0.9485 |
| 8 | 0.9413 |
| 9 | 0.9342 |
| 10 | 0.9272 |
| 11 | 0.9202 |
| 12 | 0.9133 |
| 13 | 0.9064 |
| 14 | 0.8996 |
| 15 | 0.8928 |
| 16 | 0.8861 |

$$\text{FLOW RATE} = (\text{ROTO RDG.}) \times (\text{CF}) \times \sqrt{29.97/(\text{B.P.})}$$

$$\text{EFF} = \frac{\text{CPM (CHECK SOURCE)} - \text{BKGD CPM}}{\text{DIN (CHECK SOURCE)}}$$

$$\text{WL} = \frac{\text{SAMPLE CPM} - \text{BKGD CPM}}{K \times \text{EFF} \times \text{SAMPLE LENGTH} \times \text{FLOW RATE}}$$

$$\text{Rn pCi/l} = \frac{\text{SAMPLE CPM} - \text{BKGD CPM}}{\Delta \text{ FLASK VOLUME} \times \text{DECAY FACTOR}}$$

$$\text{Z EQUILIBRIUM} = \frac{\text{WL} \times 10,000}{\text{Rn pCi/l}}$$

COUNTER No. :

COUNTER EFF. :

SAMPLE LENGTH :

BARO. PRESS. :

ROTONETER No. :

CF (SLOPE) :

Y-INTERCEPT:



4. Repeat step 3, using the standardized electroplated disk alpha source in place of the filter paper, to obtain two 10-minute counts for use in calculating the counting system efficiency.
5. Repeat step 3 for each alpha scintillation cell which will be used to make field measurements, in order to obtain the background count rate for each cell. Note that the extender cap for the counting chamber is required for counting cells, in place of the flat cap, and that 30-minute counts for cell background are preferable to 10-minute counts whenever possible. Record the cell (or flask) background counts and count times in the appropriate block on the data form.

Note on alpha scintillation cell preparation: each alpha scintillation cell should be evacuated (using the hand vacuum pump in the monitoring kit or some other appropriate vacuum source to remove the current radon sample) at least 4 hours before commencing the next background count, to allow any residual radon daughter activity to decay away. For measurements of radon in the range commonly found in residences (about 1-10 pCi/l), the background for any cell should not exceed 1 cpm, although higher background count rates may be tolerable for higher expected radon concentrations. If the background is excessive, the cell should be re-evacuated or purged with aged air (or dry nitrogen) and allowed to stand 2-4 hours before re-evaluating the background count rate.

Sample Acquisition

1. Enter the owner's name of the location to be sampled, the address, survey date, and your name (as surveyor) in the appropriate spaces at the top of the data form. Use one form for each structure surveyed, and additional forms as required. Also enter the uncorrected barometric pressure, obtained from the altimeter/barometer in the kit, in the appropriate space on the data form.
2. The pump (Staplex model BN rechargeable type or equal) should be fully charged for proper operation. Do not operate the pump while it is connected to 115V ac power, as damage may result. Four to eight hours of charging is usually sufficient for normal operation.
3. Connect the pump, alpha scintillation cell, and the filter holder assembly (containing an unused membrane filter, Millipore type HA, 0.45-micron pore size, 25-mm diameter) as shown in Figure 2. Connections to the cell are made with male Swagelok quick-disconnect fittings which must be pressed firmly into the female connector until a distinct "click" is heard. All other fittings should be checked to assure they are gas-tight. Record the sample location, pump number, flask or cell number, rotometer number, and counter serial number on the data form.
4. Using the rotometer and the specially modified rubber stopper provided in the monitoring kit, measure the initial air flow rate through the sampling train by pressing the rubber stopper firmly

BY PCN/BAK-BP. DATE 6-28-84 SUBJECT Radon/Radon Daughter
CHKD. BY DATE Sampling Train Layout

SHEET NO. 1 OF 1
JOB NO.

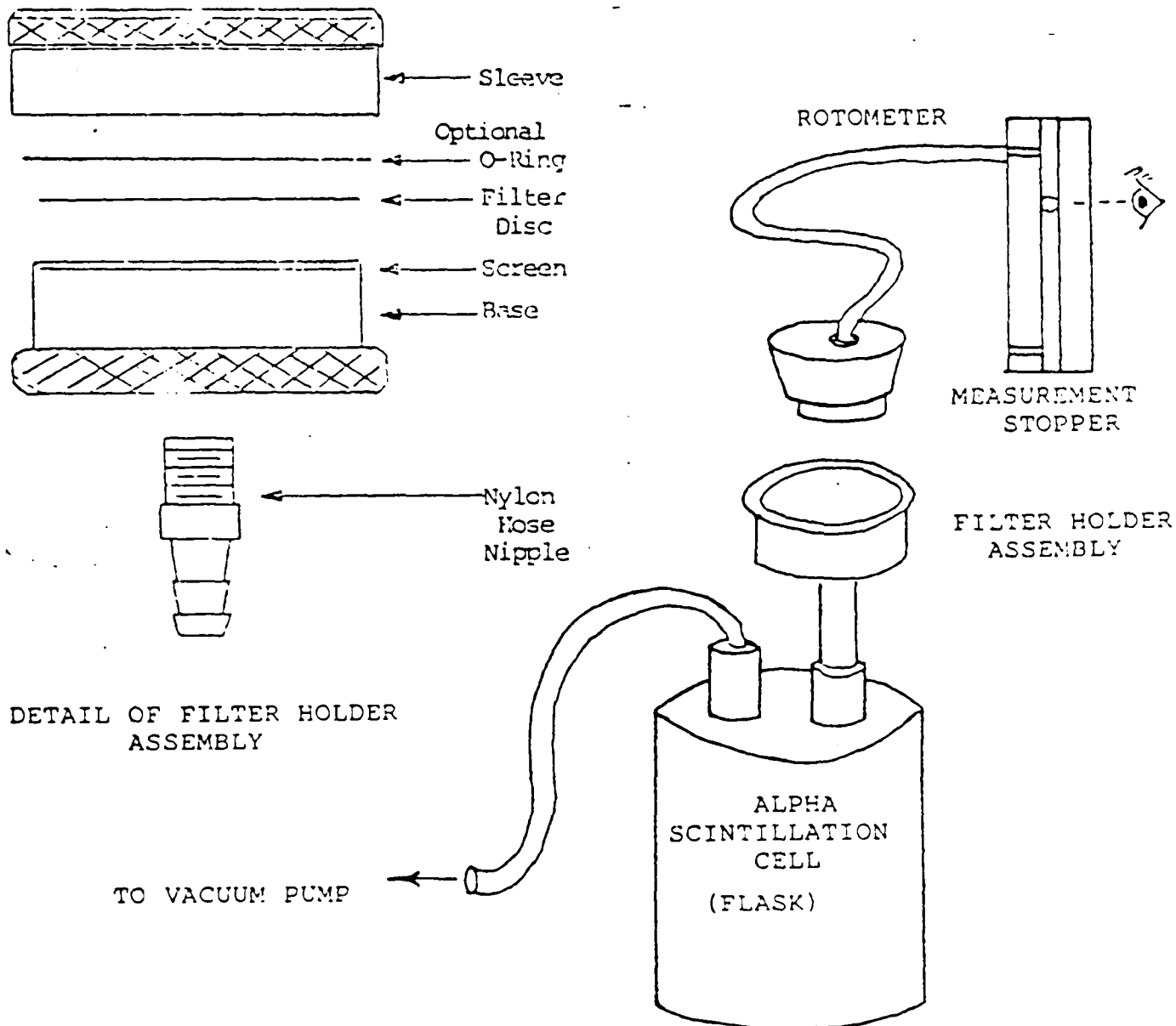


Figure 2. Sampling Configuration for Radon and Radon Daughters

into the front of the filter holder. The rotometer should be held vertically at eye level, and the reading should be made at the center of the ball. If the flow rate exceeds the maximum value of the rotometer, the flow may be reduced by use of a needle valve at the pump. When making this measurement, the stopper should be inserted in the filter before the pump is turned on, and the pump should be run only long enough to obtain the rotometer reading, in order to minimize the particulate accumulation on the filter surface prior to the actual sampling period. Record the rotometer reading on the data form. Once that has been done, the stopper should be removed and the system is now ready for sampling.

5. Remove the stopwatch from the monitoring kit, turn it on, and reset it to zero. Also note the exact time of day that the sampling began, using a watch or other convenient means. When everything is ready, start the stopwatch and the pump simultaneously.

Note: It has been found very useful to start the sample on some even minute according to the monitor's wristwatch. In this way, the sampling/counting sequence can be maintained, even if the stopwatch should malfunction. The time of day is also necessary for the computation of the delay between the sample time and the cell count time.

6. At exactly 5 minutes elapsed time, turn the pump off. Reconnect the stopper and rotometer to the front of the filter holder assembly as in step 4 and turn the pump on only long enough to obtain a final rotometer reading. Record the final rotometer reading on the data form. Disconnect the fittings from the cell, and set the cell aside for later evaluation. Carefully open the filter holder assembly and remove the filter, using the tweezers provided in the kit. Place the filter, with the collection side down, into one of scintillator trays in preparation for counting.

Evaluation of the Radon Daughter Sample

1. Assure that the counting system (EDA Instruments, Inc. model RDA-200) has been checked and found operational, and that a 5-minute filtered grab sample has been properly acquired.
2. Turn the counting system "OFF," open the counting chamber, and remove any scintillator trays or cells from the chamber. Place the scintillator tray, containing the filter to be evaluated, into the counting chamber after removing the protective plastic cap from the tray (if necessary). Reclose the counting chamber with the flat chamber cap. Set the "TIME (MIN)" selector to "10" (for a 10-minute count) and turn the "POWER" switch to "INT." Wait at least two minutes for any residual light activation to die away.
3. At any time between 40 and 90 minutes after the start of sampling, press the "START" button to initiate the count. Enter the actual count start time on the data form (or record the delay time from the

stopwatch). If necessary, calculate the delay from the start of sampling to the start of counting, in minutes, and record it on the data form. Note: The following formula will only work using a 5 minute sample time and a 10 minute count time.

4. When the count is complete, record the total sample counts and the count time (10 minutes) on the data form. The "POWER" switch should be turned to "OFF" and the scintillator tray and sample removed from the counting chamber. The system is now ready to receive the next sample.
5. Calculate the actual flowrate, in liters per minute, from the relation:

$$\text{Flowrate} = (\text{Roto Rdg}) \times (\text{CF}) \times \sqrt{29.92/\text{Bar. Press.}}$$

where: Roto Rdg is the rotometer reading
CF is the correction factor for the rotometer, noted on the calibration sticker on the side of the rotometer.
Bar. Press. is the uncorrected local barometric pressure, obtained from the altimeter/barometer in the kit.

Record the actual flowrate on the data form.

6. Calculate the counting efficiency of the counting system from the relation:

$$\text{Eff.} = \frac{\text{cpm of check source}}{\text{dpm of check source}}$$

where: cpm is the count rate of the standardized, electroplated alpha source measured during system checkout
dpm is the true disintegration rate of the alpha source, noted on its storage container.

Record the efficiency on the data form.

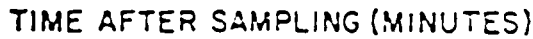
7. Calculate the radon daughter concentration, in units of working level, from the relation:

$$\text{WL} = \frac{\text{sample cpm} - \text{bkg cpm}}{K \times \text{Eff.} \times \text{Sample length (min.)} \times \text{Flowrate}}$$

where: sample cpm is the count rate of the sample
bkg cpm is the background count rate, obtained during checkout
K is the Kusnetz factor from Table 1, based on the delay period, in minutes, from the end of sampling to the mid-point of the count period
Eff. is the system counting efficiency (calculated above)
Sample length is 5 minutes
Flowrate is as calculated above

Record the WL on the data form.

• •



Factors for Determining Multiple of Working Level of Radon Daughter Products in the Atmosphere

[illegible]

Yes ___ No ___ N/A ___ 6. Are there any documents in the file that are not on the inventory?

Comments: _____

Yes ___ No ___ N/A ___ 7. Is the file stored in a secure area?

Comments: _____

Yes ___ No ___ N/A ___ 8. Are there any project documents that have been declared enforcement sensitive?

Comments: _____

DOCUMENT AUDIT CHECKLIST

Enforcement Sensitive Documents

PROJECT NO. _____ DATE OF AUDIT _____
PROJECT LOCATION _____ SIGNATURE OF AUDITOR _____
OFFICE LOCATION _____

Yes ___ No ___ N/A ___ 1. Are Enforcement Sensitive documents stored in
a secure area separate from other project
documents?
Comments: _____

Yes ___ No ___ N/A ___ 2. Are Enforcement Sensitive documents listed in
the project file?
Comments: _____

Yes ___ No ___ N/A ___ 3. Is access to Enforcement Sensitive files
restricted?
Comments: _____

Yes ___ No ___ N/A ___ 4. Have classified documents been marked or
stamped "Enforcement Sensitive?"
Comments: _____

Yes ___ No ___ N/A ___ 5. Is classified information inventoried?
Comments: _____

Yes ___ No ___ N/A ___ 6. Is classified information numbered for
document control?

Comments: _____

DOCUMENT AUDIT CHECKLIST

Active Project Files

PROJECT NO. _____ DATE OF AUDIT _____

PROJECT LOCATION _____ SIGNATURE OF AUDITOR _____

OFFICE LOCATION _____

Yes ___ No ___ N/A ___ 1. Are project notebooks being maintained in accordance with CH2M HILL policies?
Comments: _____

Yes ___ No ___ N/A ___ 2. Are project activities logbooks being kept up to date?
Comments: _____

Yes ___ No ___ N/A ___ 3. Is each entry in the project activities logbook identified by date and author, if made by persons not originally assigned to the book?
Comments: _____

Yes ___ No ___ N/A ___ 4. Are entries legible, factual, and made in ink?
Comments: _____

Yes ___ No ___ N/A ___ 5. Are modifications to the project workplan noted in the project activities logbook or elsewhere?
Comments: _____

- Yes ___ No ___ N/A ___ 6. Is an inventory of serialized field documents (Sample I.D. Tags, Chain-of-Custody Records, etc.) in the RDCO's inventory logbook?
Comments: _____

- Yes ___ No ___ N/A ___ 7. Does the Field Notebook contain adequate information about each sample including the Sample I.D. Tag number, date, location, and information necessary to reconstruct the sample?
Comments: _____

- Yes ___ No ___ N/A ___ 8. Are entries to the Field Notebook made in ink?
Comments: _____

- Yes ___ No ___ N/A ___ 9. Are corrections properly executed with one line through the error in all project logbooks and Field Notebooks?
Comments: _____

- Yes ___ No ___ N/A ___ 10. Are all project notebooks and logbooks properly labeled with the project number, EPA site number and title?
Comments: _____

DOCUMENT AUDIT CHECKLIST

Regional Document Control Officer

OFFICE LOCATION _____

DATE OF AUDIT _____

SIGNATURE OF AUDITOR _____

- Yes ___ No ___ N/A ___ 1. Is an inventory of serialized field documents (Sample I.D. Tags, Chain-of-Custody Records, Receipt-for-Samples Form, etc) in the RDCO's inventory logbook?

Comments: _____

- Yes ___ No ___ N/A ___ 2. Are project materials secured during other than working hours unless they are in use?

Comments: _____

- Yes ___ No ___ N/A ___ 3. Is Enforcement Sensitive material maintained in a secured area with a check-out log at all times?

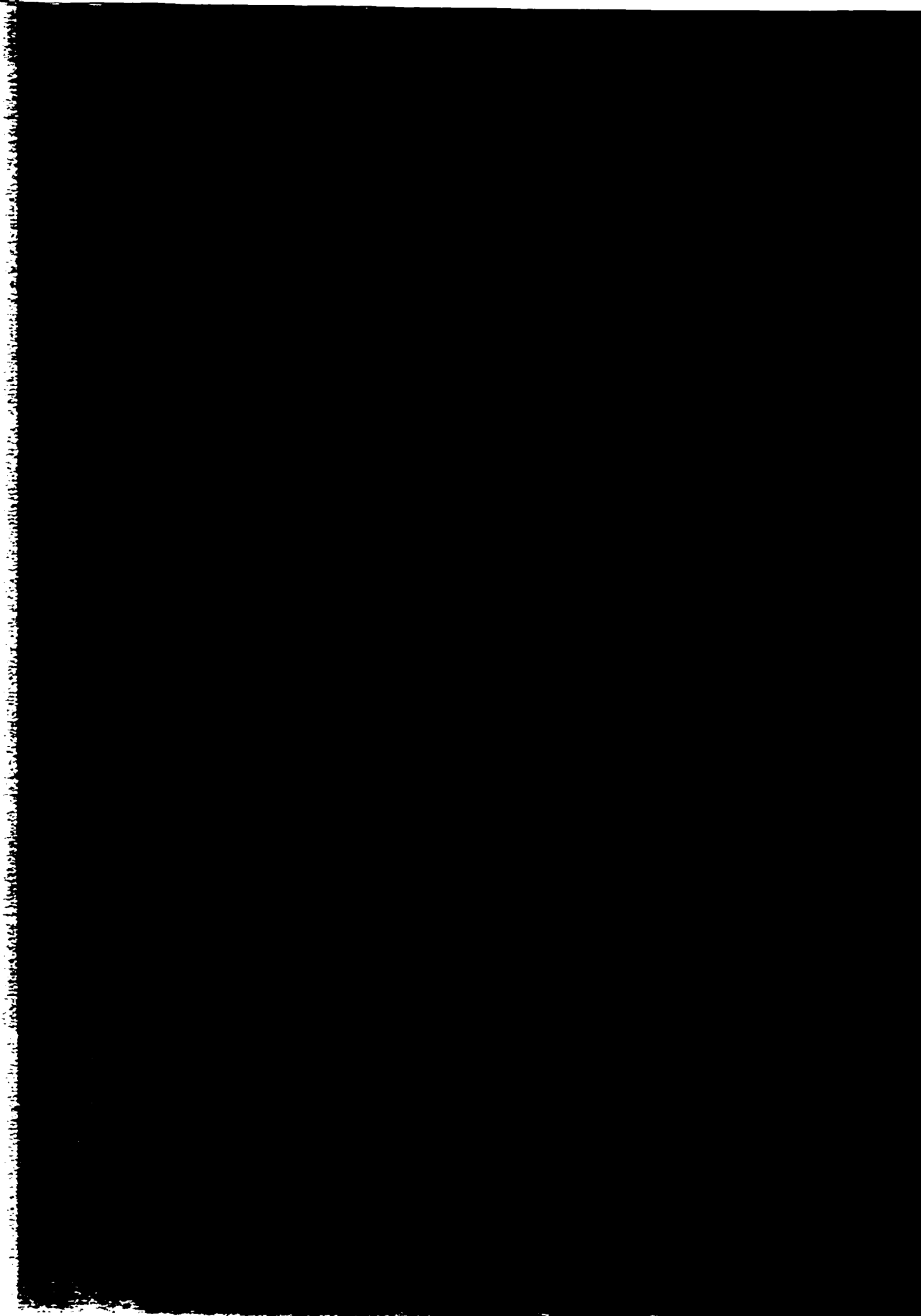
Comments: _____

DE/DENRD2/064

ITE

SAFETY PLAN

.7L89.0



CH2M HILL
SITE SAFETY PLAN FOR FIELD INVESTIGATIONS

I. GENERAL INFORMATION

CLIENT: REM/FIT JOB NO: W67201.00
PROJECT MANAGER: Dick Moos/Denver
SITE: Cherokee County Site (Tar Creek)-Galena Subsite
SITE LOCATION: Cherokee County, southeast Kansas

PURPOSE OF FIELD VISIT(S): Phase I RI
DATE OF VISIT(S): June-August, 1985
BACKGROUND INFORMATION: Complete _____ Preliminary X
INFORMATION AVAILABLE FROM: DEN (office)
OVERALL HAZARD SUMMARY: Serious _____ Moderate _____
Low X Unknown _____

II. SITE/WASTE CHARACTERISTICS

DESCRIPTION

The Cherokee County site is the Kansas portion of the Tri-State Mining District. This District, now inactive, covered approximately 500 square miles, including portions of Cherokee County, Kansas; Ottawa County, Oklahoma; and Jasper County, Missouri. It was one of the most productive lead and zinc mining areas in the U.S., with underground mining operations ranging in depths between 50 and 400 ft. The mineral zone coincided with the shallow aquifer in the region. The area is now honeycombed with abandoned mines.

When mining activity ceased, water was no longer pumped out of the mines and they began filling through groundwater recharge and surface water runoff. As a result, the groundwater in the abandoned

mine workings became highly mineralized, and this contaminated water has impacted groundwater and surface water systems. Adding to the degradation of surface and groundwaters is runoff from barren mined lands, chat piles, and tailings ponds which are located throughout the area. Tar Creek is the principal basin that has experienced water quality degradation by acid mine waters. Open mine shafts and subsidence areas are common in the mined areas.

The Galena subsite is a rural community of 3,600. The smelter at Galena, closed in 1971, was the major smelting operation in the area. Abandoned mine workings surround the town, a large subsidence area is adjacent to the high school, and subsidence has occurred within the city limits.

Features and Unusual Features (water supply, telephone, radio, power lines, gas lines, watermains, terrain, etc.):

Large chat piles exceeding 100 feet in height, abandoned mine shafts, barren mine lands, areas of subsidence or collapses, and tailings ponds. A major smelter operation, now inactive, is located just northeast of Galena.

Status (active, inactive, unknown): inactive

History (worker or non-worker injury; complaints from public; previous agency action):

Some studies have been conducted on the surface water and groundwater quality of the area, and soils and vegetation in the area downwind of the smelter at Galena have been analyzed for heavy metal contamination. Air quality studies are currently being conducted because of a 1981 epidemiological report which indicated a higher than average rate of lung cancer in Cherokee County. A Remedial Investigation and Feasibility Study have been completed in the lower Tar

Creek watershed in Oklahoma to address the water quality degradation problems in that area.

WASTE TYPE(S)

Liquid X Solid X Sludge Gas

CHARACTERISTIC(S)

Corrosive X Ignitable Radioactive
Volatile Toxic X Reactive Unknown Other (Name)

HAZARD EVALUATION

Data from prior studies in the Cherokee County area were evaluated and summarized by the project staff during early phases of this project (Phase I Report on Existing Literature Review and Evaluation, December 18, 1984; Draft Existing Data Evaluation--Galena Subsite, May 24, 1985). The shallow groundwater aquifer apparently contains naturally high iron, sulfate, and manganese levels, but concentrations of heavy metals in well water samples generally have not exceeded drinking water standards. Water samples from open mine shafts, however, exhibit high concentrations of cadmium and zinc (20 to 340 ppm Cd and 60 to 1,900 ppm Pb). The pH of water in open mine shafts may range as low as 3.6 to 5.2.

Acid mine drainage has noticeably impacted Short Creek along the north edge of Galena, but surface water quality of Shoal Creek and Spring River (south and west of Galena, respectively) is generally within acceptable levels. Short Creek contains concentrations of cadmium, lead, manganese, and zinc in excess of EPA water quality criteria. The maximum reported concentrations from existing literature are: cadmium--540 ppm, lead--5,500 ppm, manganese--3,500 ppm, and zinc--100,000 ppm. Surface water is acidic in contaminated

areas with pH levels down to 4.6 in the Galena area (lower pH's have been reported in the Tar Creek drainage).

Soils data from the zone immediately downwind of the Galena smelter indicate that cadmium, zinc, lead, and copper levels had been, and may continue to be, higher than metal concentrations in soils outside the smelter plume area. Biological data (vegetation, milk, blood, and hair) also indicate that the downwind area had been impacted by airborne pollutants from the now inactive smelter.

Air quality data from 1982 through 1984 indicate that the total suspended particulates in the Galena area are generally within acceptable limits (NAAQS). During 1970 through 1971 when the smelter was still operating, the lead, zinc, and cadmium levels were elevated in air quality samples taken downwind of the smelter, but lead levels did not exceed the NAAQS standard of $1.5 \mu\text{g}/\text{m}^3$.

Physical hazards are a major concern on this site. Care should be taken when walking in mined areas because loose alluvial material covers the ground in most subsidence areas and new subsidences could occur. Tailings piles could become unstable. Use caution when approaching open mine shafts and test holes because the loose alluvium can fail and cave into the shaft.

III. SITE SAFETY WORK PLAN

PERIMETER ESTABLISHMENT

Map/Sketch Attached Yes Site Secured No
Perimeter Identified No Zone(s) of Contamination Identified Partially

Note: Map must be attached to this plan.

SITE PERSONNEL

Level of Protection:

A _____ B _____ C X D X

Modifications:

Work clothes, neoprene steel toe/shank boots for wet areas, steel toe/shank work boots for general field work, cotton work gloves, tyvek coveralls, and safety goggles should be used for dusty conditions and when field work is expected to cause dusty or muddy conditions. Have a hard hat available if reconnaissance requires proximity to machinery or overhead hazards.

Equipment and Materials: TLD badge, first aid kit, eye wash kit, stretcher or blanket, water sprayer, clean water, paper cups, soap, wind direction indicator (i.e., flag or tape), disposable dust mask or APR w/high efficiency particulate cartridges, safety or climbing rope, tow chain, drinking water or Gator Aid.

SITE ENTRY PROCEDURES

If conditions are windy and dry and field work creates dust, wear disposable dust masks while conducting field studies. If dust conditions are heavy wear APR's and remain upwind whenever possible, or postpone field work. The RI Team Leader will be responsible for monitoring wind/dust conditions and upgrading safety gear.

WORK LIMITATIONS (Time of day, etc.)

- No field work will be conducted on windy days when dust is heavy unless tyvex and APR's are worn.

- Site visits and field work will be conducted only during daylight hours.
- No unnecessary climbing on tailings or chat piles.
- No entry into mine shafts or exposed mine tunnels because they may be unstable. Vertical open mine shafts may be very deep and are especially hazardous.
- Do not walk in areas exhibiting noticeable surface cracks or depressions because they may be indicative of subsidence areas.
- For limited sampling from boats, life jackets will be worn and appropriate safety equipment for small boats will be required.

DECONTAMINATION PROCEDURES

Personnel: After working in mined areas or in dusty areas thoroughly clean or spray boots, especially the soles, prior to getting back into the vehicle. Wash hands and face prior to eating, drinking or smoking. Shower, wash hair, and change clothes after each day in the field. Work clothes should be laundered frequently if not wearing tyveks. Use of disposable boots, when practical, would eliminate the need for boot decon.

Note: Boots may be removed and sealed in plastic bags while driving between sampling locations to reduce the need for decon. Boots must be thoroughly washed at the end of each work day.

Need: Clean washwater or premoist towelettes to wash hands and face. A water sprayer for equipment rinse in the field. Plastic garbage bags for tyvek disposal and boot transport.

Equipment: The interior of the field vehicles are to be washed and vacuumed at periodic intervals.

DISPOSAL OF MATERIALS GENERATED ON SITE

Place disposable clothing and work generated waste material in plastic bags and dispose of in county landfill or at solid waste collection facilities affiliated with the county landfill.

IV. EMERGENCY INFORMATION:

To be provided prior to initial field recon.

LOCAL

Ambulance

Hospital

Poison Control Center

Police/Sheriff

Fire

Electric Co.

Gas Co.

Water Co.

Airport

Explosives Unit

EMERGENCY ROUTES

To be provided and driven prior to initial field recon and approval.

HOSPITAL

OTHER

EMERGENCY CONTACTS

1. Dr. Raymond Harbison, Ph.D. (University of Arkansas, Medical)
Phone: 501-661-5766 or 661-5767
501-370-8263 (24 hr)
2. Mary Anne Chillingworth/Washington, D.C., Health and Safety
Director
Phone: 703-620-5200 (O)
703-476-0882 (H)
3. Donna J. LaBar/Portland, Oregon, Assistant Health and Safety
Director
Phone: 503-224-9190 (O)
503-775-9017 (H)
4. Occupational Physician (CH2M HILL)
Name: Dr. R. Burtan
Phone: 303-758-1482
Address: Tridem Service, Ltd.
1600 S. Albion Street, Suite 700
Denver, Colorado 80222

Team members under his care:

Dick Moos
Keith Piontek
Eric Pankstaitis

Occupational Physician (SRW Associates)

Name: Dr. G. Alan Yeasted

Phone: 412-561-1484

Address: Mount Lebanon Diagnostic Clinic
300 Cedar Boulevard
Pittsburgh, Pennsylvania 15228

Team members under his care:

| | |
|----------------|----------------|
| E. McLean | B. H. Laswell |
| E. H. Brown | J. P. Ackerman |
| L. L. Ladd | D. Brent |
| P. W. Tomiczek | P. Sullivan |
| D. B. Thompson | |

Occupation Physician (Phoenix Safety Associates, Ltd)

Name: Dr. Lorna Stuart

Phone: 215-935-7300

Address: 604 Gay Street
Phoenixville, Pennsylvania 19460

Team members under his care:

Don Wolski

5. Project Manager

Name: Dick Moos/Denver, Colorado

Phone: 303-771-0900 (O)
303-841-4138 (H)

6. Client Contact

Name: Alice Fuerst, Kansas City, Kansas

Phone: 816-374-6864 (O)
816-229-7441 (H)

7. Remedial Planning Team Leader (RPTL)

Name: Mike Thompson, Kansas City, Kansas

Phone: 913-451-5945 (O)

913-451-4953 (H)

V. PLAN APPROVAL

PLAN PREPARED BY: Mary Ann Chillingworth Date: May 17, 1985

APPROVED BY: *Wanna Johnson* Date: *21 June 1985*

Emergency info required!

DE/CC/147

Evaluation of the Radon Sample

1. Assure that the counting system (EDA Instruments, Inc. model RDA-200) has been checked and found operational, and that at least 4 hours have elapsed since the alpha scintillation cell was filled.
2. Turn the counting system "OFF," open the counting chamber, and remove any scintillator trays or cells from the chamber. Place the cell to be evaluated into the chamber, window side down, after removing the protective plastic cap. Reclose the counting chamber with the extended chamber cap. Set the "TIME (MIN)" selector to 10 minutes (for a 10-minute count) and turn the "POWER" switch to "INT." Wait at least 2 minutes for any residual light activation to die away.
3. Press the "START" button to initiate the count, and note the date and time of the count on the data form.
4. When the count is complete, record the count on the data form and repeat steps 3 and 4 until three 10-minute counts have been recorded. Alternatively, one or more 30-minute counts may suffice for this.
5. Turn the counting system "OFF" and remove the cell from the counting chamber. The system is now ready to receive the next sample.
6. Calculate the number of hours of decay of the sample, from sample collection time to the mid-point of the counting period, and record it on the data form. Calculate the average of three sample counts and record it also.
7. Calculate the radon concentration, in units of picocuries per liter, from the relation:

$$\text{Radon pCi/l} = \frac{\text{sample cpm} - \text{bkg cpm}}{\text{CF} \times \text{Flask Volume (l)} \times \text{decay factor}}$$

where: sample cpm is the average count rate of the sample
bkg cpm is the cell background count rate
CF is the average cell/system counting efficiency, in units of cpm/pCi, obtained from the most recent calibration (typically 3-4)
Flask Volume is 0.16 liter (average for model RDX-013 cells)
decay factor is based on the time between sample collection and the mid-point of the counting period, taken from the table on the data form, or calculated by $e^{-0.00756t}$, where t is the decay time in hours

Record the radon concentration on the data form.

8. Calculate the working level ratio, often called the "percent equilibrium," as follows:

$$\% \text{ Equil} = \frac{(\text{WL}) \times 10,000}{\text{Radon pCi/l}}$$

where: WL and Radon pCi/l are as calculated previously

Record the equilibrium on the data form.

REFERENCES

- ANS173 American National Standard for Radiation Protection in Uranium Mines, ANSI N13.8 - 1973 et seq.
- Lu57 Lucas, H.F., Jr., "Improved Low Level Alpha Scintillation Counter for Radon," Rev. Sci. Instrum. 28, 680-683 (1957)
- Ro72 Rolfe, R., Health Physics 22, 233 (March, 1972)
- Th70 Thomas, J.W., Health Physics 19, 691 (1970)
- Th71 Thomas, J.W., Personal Communication (July 1971)

APPENDIX A

RADON/RADON PROGENY FIELD MONITORING KIT #

- ZERO Centurian Carrying Case, lock no.
- Scintillation Counter, EDA Instruments model RDA-200, s/n (EPA#)
 - with -Alpha Scintillation Cells
 - Scintillat
 - 1-Power Supply, 115 Vac
 - Swagelok Quick- Connect Tube Fittings
 - 1-Standard Scintillation Cell, s/n
 - 1-PM Tube Housing Cover (used when counting cells)
 - 1-PM Tube Housing Cover (used when counting filters)
 - Alpha Check Source (isotope , s/n)
 - 1-Instruction Manual
- Air Pump, Staplex model , s/n (EPA#)
- Air Pump,
- Flow Measurement Stoppers, for 25-mm filters, with Luer-Lok fittings
- Filter Holders, 25mm, open face, with Luer-Lok fittings
- Filter Holders, 25mm, open face, with 1/4" barb fittings
- Filter Holders, 25mm, in-line, with 1/4" barb fittings
- Rotometer, Dwyer model VFA-22 (), ORP-LVF #
- Rotometer, Dwyer model VFA-23 (0.6 - 5 lpm), ORP-LVF #
- Rotometer, Dwyer model VFB-63 (3-30 lpm), ORP-LVF #
- Boxes, Millipore filters, 100 ea., 25mm, micron (type)
- Spare Luer-Lok/barb fitting, male
- Spare Luer-Lok/barb fitting, female
- Digital Electronic Stopwatch, with case, ORP-LVF #
- Altimeter/Barometer, with case
- Kitchen Timer, spring wound, 60 minute
- Hand Vacuum Pump, Nalgene "Mityvac"
- 8-Spare "C" Batteries (for EDA)
- 3-Spare "AA" Batteries (for stopwatch)
- 1-3-Prong to 2-Prong a/c Adapter Plug
- 1-Extension Cord, 8'
- 1- Tweezers

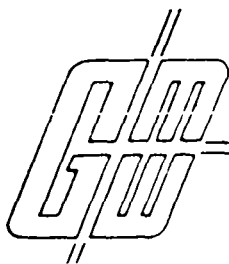
Section No. B.13
Revision No. 2
Date: 8/6/85
Page: B56 of B56

B.13.14 GENERAL METAL WORKS HIGH VOLUME AIR SAMPLERS

GMW HIGH VOLUME AIR SAMPLERS

GENERAL METAL WORKS INC.

8363 BRIDGETOWN ROAD / VILLAGE OF CLEVELAND, OHIO 44102 / TEL 910-941-2229



ACKNOWLEDGEMENT

General Metal Works Inc., extends its sincere gratitude to the many individuals and organizations whose efforts have been instrumental in the development of the high volume air sampler to its present state. We especially wish to commend the personnel of the United States Environmental Protection Agency whose efforts and investigations have contributed significantly to the definition and operation of this equipment.

CONTENTS

| | PAGE |
|---|-------|
| Introduction & Applications | 3 |
| Shelter Assembly | 4 |
| Calibration Kit GMW - 25 | 5 |
| GMWL - 2000 | |
| Description & Specifications | 6 |
| Sampler Calibration | 7 |
| Sampler Operation | 8 |
| Replacement Parts | 9 |
| Model FH - 2100 Filter Holder Replacement Parts | 9 |
| GMWL - 2000 H | |
| Description & Specifications | 10 |
| Sampler Calibration | 11 |
| Sampler Operation | 12-13 |
| Replacement Parts | 14 |
| Timer/Programmer (Sixth Day) GMW - 800 | 15 |
| GMWS - 2310 ACCU-VOL | |
| Description & Specifications | 16 |
| Sampler Calibration | 17 |
| Converting Procedures | 18 |
| GMW - 8550 Sampl-Saver | 19 |
| Portable Air Samplers | |
| Tripod GMWT 2200 Description & Specifications | 20 |
| Sampler Assembly, Calibration & Operation | 21 |
| Handi-Vol 2000 Description & Specifications | 20 |
| Sampler Calibration | 22 |
| Sampler Operation & Maintenance | 23 |
| Motor Brush Replacement | 24 |
| Motor Brush Seating Procedure | 25 |
| Filter Paper Cartridge GMW - 3000 | 26 |
| Calibration Data Sheet | 27 |

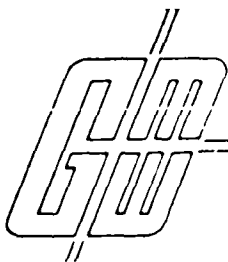
INTRODUCTION

The High Volume Air Sampler is the recommended instrument for sampling large volumes of air for the collection of suspended particulate matter. The physical design of the sampler is based on aerodynamic principles which result in the collection of particles of 100 microns (Stokes Equivalent Diameter) and less. The Sampler consists of a blower/motor unit and a supporting screen for the filter ahead of the blower/motor unit. During the sampling operation, the sampler is supported in a protective shelter so that the 8" x 10" surface of the filter is in a horizontal position. In its basic configuration (Model GMWL 2000) a flow meter is connected to a pressure tap at the exhaust end of the motor. The sampler may be modified (Model GMWL 2000 H) to incorporate a continuous flow device for recording the air flow over the entire sampling period.

It is the intent of this manual to instruct the user in the operating techniques. For information on air sampling principles, procedures and requirements, contact the local E.P.A. office serving your area.

Various applications for this equipment include:

- Ambient air monitoring to determine suspended particulate levels relative to air quality standards.
- Impact of a specific source on ambient levels of suspended particulates by incorporating a "wind-direction-activation" modification which permits the sampler to operate only when conditions are such that a source-receptor relationship exists.
- Monitoring of enclosed environments for relatively high levels of particulate matter, particularly toxic materials.
- Monitoring of emissions from large diameter vents where physical conditions preclude the use of conventional stack-testing equipment.



SHELTER ASSEMBLY

NOTE! REMOVE MOTOR SHIPPING STRAPS
BEFORE SERVICING SAMPLER.

AFTER REMOVAL FROM THE SHIPPING CARTON
ASSEMBLE SHELTER AS FOLLOWS:

1. Locate the package that contains the front and rear catches. This bag also contains the rear lid hasp and an aluminum strip for securing the lid in an open or closed position.
2. Secure the front catch, (See Figure A), to the shelter using the two flat head screws and nuts.
3. Secure the rear catch, (See Figure A), to the shelter using one screw and nut.
4. Secure the rear lid hasp, (See Figure A), to the lid using two screws and nuts.
5. (NOTE: These three catches may need adjustment after the shelter lid is installed.)
6. Attach the lid to the shelter by placing the hinge on the "OUTSIDE" of the shelter top and tighten nuts.
7. Adjust the front and rear catches to be sure that the lid slot lowers over the front catch when closing the lid. The slot at the rear of the lid should align with the rear catch when the lid is open.
8. The lid can now be secured in an open or closed position with the aluminum strip or a padlock.

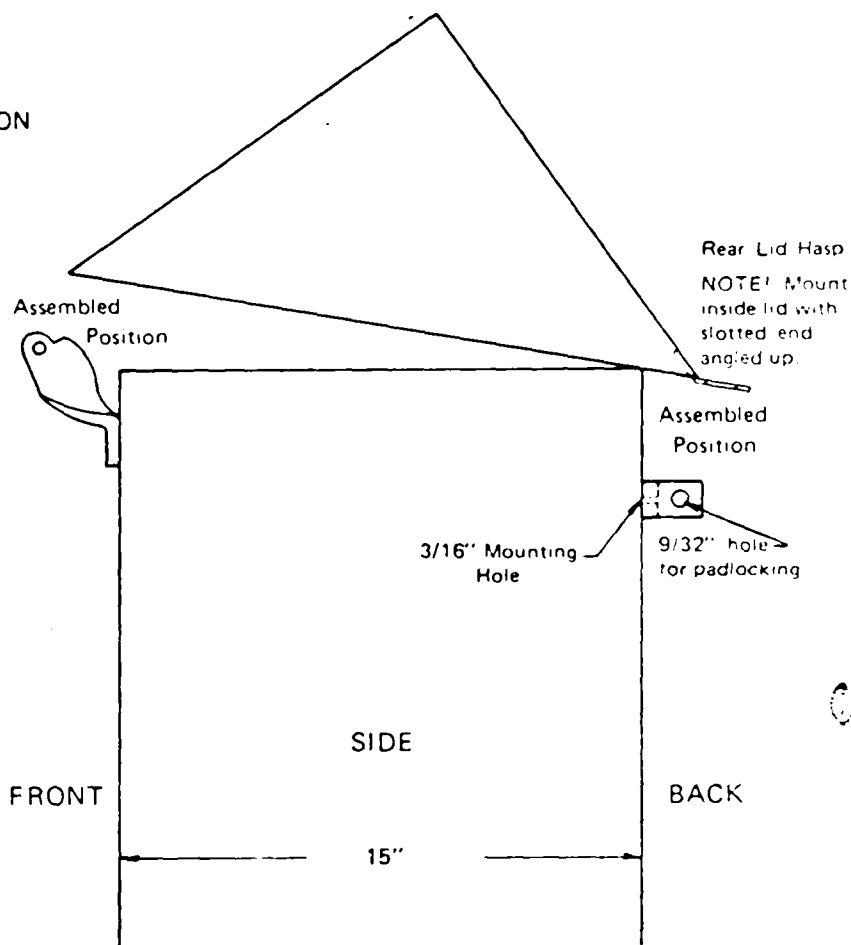


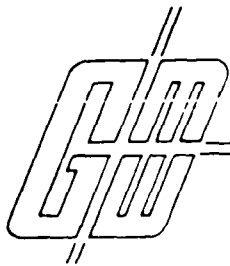
FIGURE A

GMW - 25 CALIBRATION KIT

1. Prepare the manometer as follows:

- A. Add the $\frac{3}{4}$ oz. bottle of fluorescein green concentrate to one quart of distilled water.
 - B. Remove one tubing adaptor and hex plug assembly from the manometer and fill to mid point level. Shake gently to remove air bubbles and slide scale so zero is in line with the meniscus of the two columns. (For readings in inches of mercury, fill manometer with 9 ozs. of mercury)
 - C. Replace tubing adaptor and hex plug assembly. Both tubing adaptor and hex plug assemblies must be screwed only half way in when taking pressure readings. To stow away, both tubing adaptors and hex plug assemblies must be screwed all the way in to prevent fluid loss.
 - D. To read the manometer when a pressure vacuum or differential pressure is imposed, add the number of inches one column travels up to the amount the other column travels down. Should one column travel further than the other, due to minor variations in tube I. D. or pressure imposed the accuracy of the reading thus obtained is not impaired.
2. Connect one end of the length of tubing provided to one leg of the manometer and the other to the pressure tap on the orifice calibrator.
 3. Select one of the five resistance plates and place it inside the threaded ring of the calibration orifice.
 4. The calibration orifice can now be secured to the motor/blower unit to be calibrated.
 5. For calibration procedures refer to "Unit Calibration" for models GMWL-2000 and GMWL-2000 H.





MODEL GMWL - 2000 HIGH VOLUME AIR SAMPLING SYSTEM

MODEL GMWL-2000 AIR SAMPLER

This basic unit is widely used by government and industry to collect and accurately measure airborne particulate matter by monitoring large volumes of air. Utilizing paper media, the Model GMWL-2000 traps particles as small as .01 micron in size.

Designed and built for continuous, 24-hour a day sampling, the heavy duty turbine type blower with high-speed motor is contained in a rugged but lightweight plastic housing. Four bolts, easily accessible, permit motor removal for periodic brush replacement.

The air flow rate is measured by a variable orifice meter which must be calibrated periodically to maintain on-site accuracy.

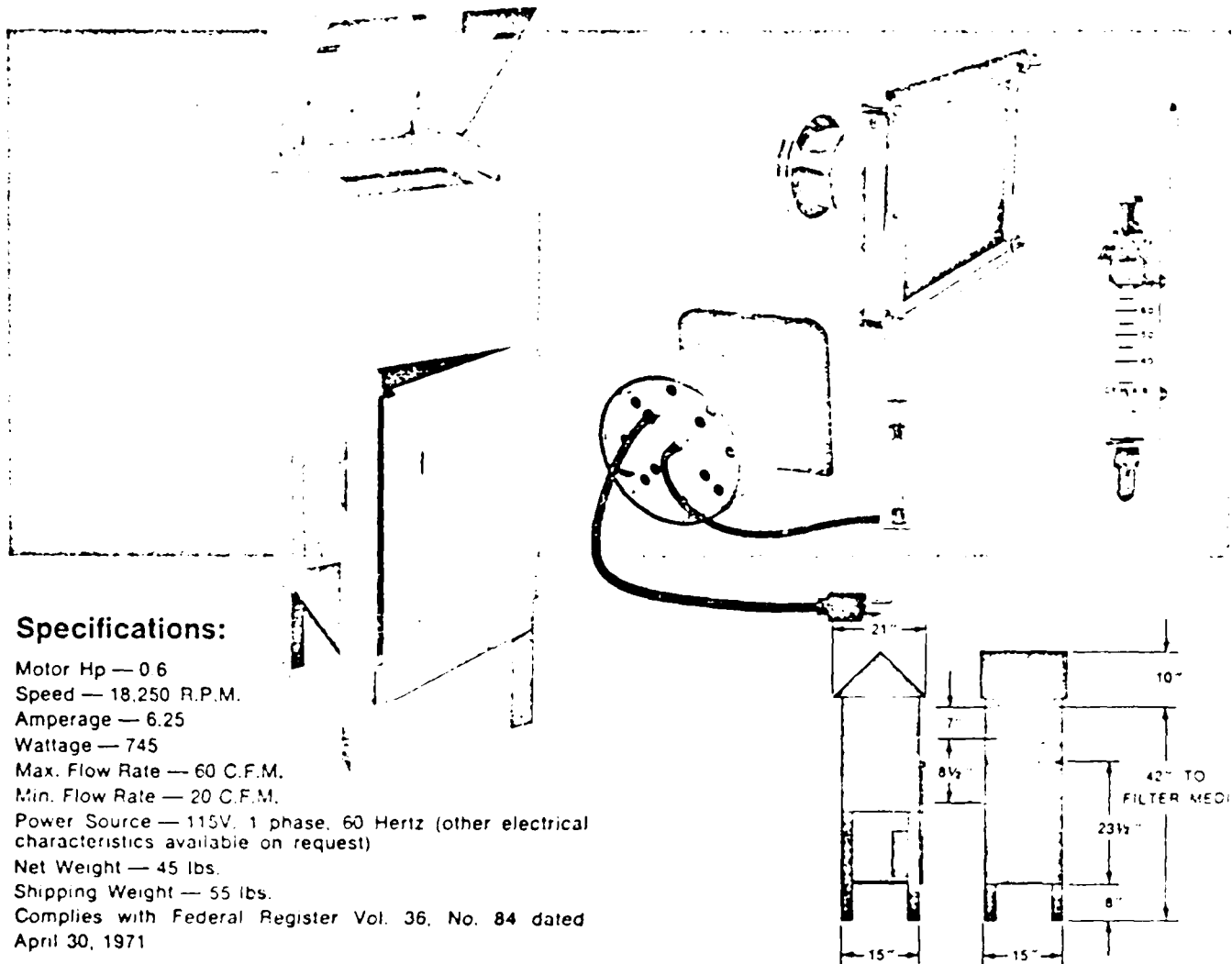
A precision bored flow meter, Model GMW 2009-2, may be substituted optionally. Encapsulated in durable acrylic, the deluxe flow meter is designed to withstand extended field service.

MODEL FH-2100 FILTER HOLDER

Designed to accommodate 8" x 10" filter paper, the Model FH-2100 Filter Holder is made of Type 304 stainless steel for maximum strength and durability. Its heavy duty **seamless** construction is leakproof and conical in shape for maximum support. Furnished complete with support screen and neoprene gasket for positive seal, the Model FH-2100 Filter Holder also accommodates the Model GMW-3000 Filter Paper Cartridge without modification. The filter holder attaches to the sampler with a threaded ring and gasket for easy assembly.

MODEL GMW-8500 ALUMINUM SHELTER

Heavily reinforced, the shelter is constructed of .080" aluminum **anodized** for outdoor service. The gable roof and large door are equipped with heavy duty **aluminum hinges** affording complete access to the components housed within. A horizontal baffle prevents sampler exhaust dust and aluminum hasps facilitate locking the gable roof in either the open or closed position.



SAMPLER CALIBRATION GMWL - 2000

EQUIPPED WITH FLOW METER

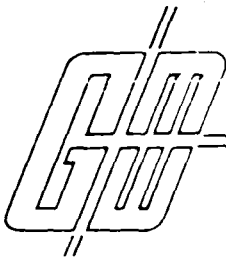
The high volume air sampler may be calibrated by means of a standard positive displacement rotary type meter. Although this is an accurate calibration method, it requires considerable time.

A much simpler procedure utilizes a calibrating orifice assembly and water manometer. (Model GMW - 25) The orifice and manometer unit are factory calibrated against the positive displacement meter and a calibration curve is drawn from the air-flow versus static pressure data.

The GMW - 25 Calibration Orifice is used for calibration of the high volume air sampler and the procedure is as follows:

1. Assemble the GMWL-2000 High Volume Air Sampler with a clean filter and operate it for at least five minutes at 115 volts.
2. Connect the flowmeter to the pressure tap at the exhaust end of the motor/blower unit using a length of tubing.
3. Hold the flowmeter vertically, loosen the locknut and adjust the flowmeter so that the middle of the float reads 60.
4. When adjustment is made, tighten the locking nut making sure the float continues to read 60.
5. Remove the motor/blower filter holder assembly from the shelter by lifting it up and out through the rectangular hole in the support pan.
6. Remove the filter holder from the motor/blower unit.
NOTE: Use of the Calibration Adapter Plate GMW-35 allows the operator to attach the calibration orifice to the motor/blower unit without removing the filter holder and motor/blower unit from the shelter.
7. Replace the filter holder with the orifice calibrator using the Number 18 Resistance Plate, supplied with the orifice calibrator.
8. Connect a water manometer to the pressure tap of the calibration orifice.
9. Plug sampler into 115V., 60 Hz. source and let it stabilize for approximately 5 minutes.
10. Read the manometer pressure in inches of water and convert to actual flow rate using the curve supplied with calibration orifice GMW-25. Record the actual flow rate and the flowmeter reading on your data sheet. (Page 27)
11. Use the remaining resistance plates (using the one with the next fewer number of holes first) until the actual flow rates and the flow meter relationship have been established.
12. Using the readings established with the above procedure, plot a curve which represents the actual flow rate versus the flow meter readings.
13. This new calibration curve is used as a direct reference to obtain the actual flow rate.

The sampler flow meter should be calibrated at least every six months and after every motor and brush change to maintain air volume accuracy.



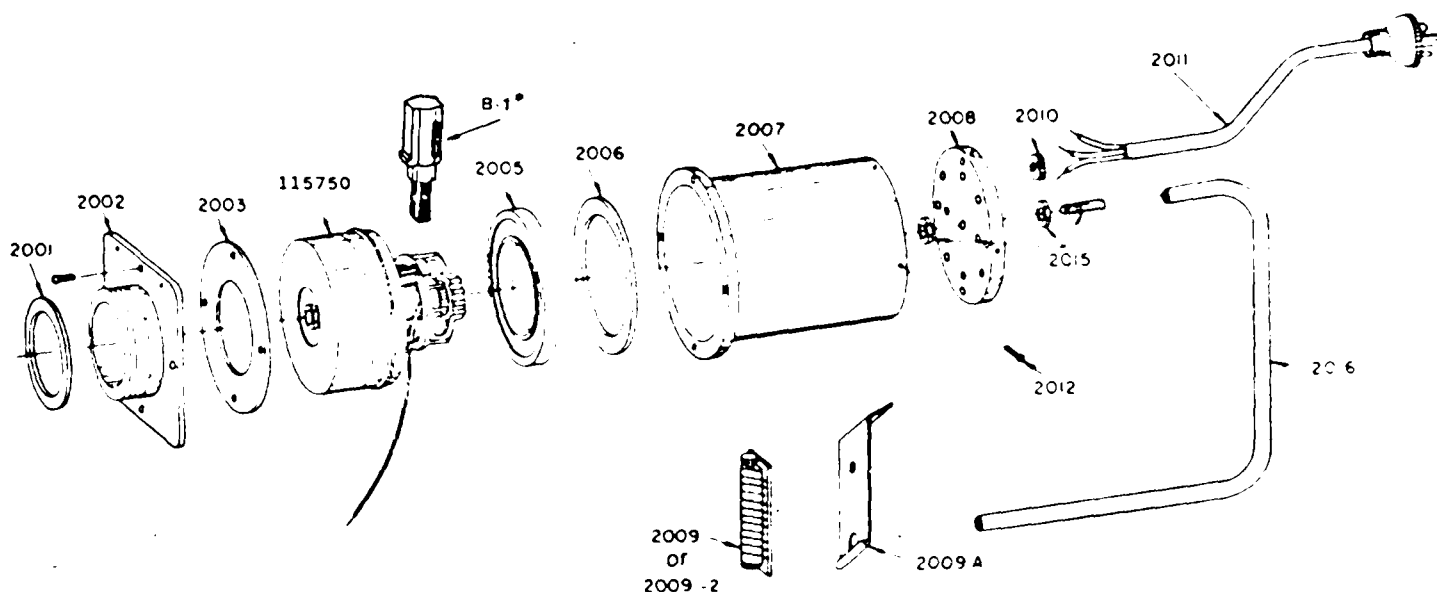
SAMPLER OPERATION GMWL - 2000

1. Place sampler and filter holder in the servicing position by raising both the sampler motor/blower unit and filter holder up until the filter holder is above the top level of the shelter. Then rotate the unit one-quarter turn so that the filter holder hangs in the rectangular hole in the sampler support pan.
2. Remove faceplate by loosening the four wing nuts allowing the swing bolts to swing down out of the way.
3. Carefully center a new filter, rougher side up, on the supporting screen. Properly align the filter on the screen so that when the faceplate is in position the gasket will form an airtight seal on the outer edges of the filter.
4. Secure the filter with the faceplate and four brass swing bolts with sufficient pressure to avoid air leakage at the edges.
5. Rotate and lower the filter holder and blower/motor assembly to its normal operating position.
6. Wipe any dirt accumulation from around the filter holder with a clean cloth.
7. Close lid carefully and secure catch with aluminum strip or padlock.
8. Plug motor/blower unit into a 115V., 60Hz. source and allow sampler to warm up for 5 minutes.
9. Connect the flow meter calibrated with the sampler to the brass pressure tap at the bottom of the motor/blower unit.
10. Hold flow meter at eye level in a vertical position and read the widest part of the float.
11. Flow measurements are taken at the beginning and end of the sampling period. Disconnect flow meter during sampling period to prevent excessive clogging.
12. After sampling period, disconnect motor/blower unit from the power source.
13. Place the sampler in the servicing position and remove the faceplate to expose the filter.
14. Carefully remove the exposed filter from the supporting screen by holding it gently at the ends (not at the corners). Fold the filter lengthwise so that sample touches sample.
15. If GMW - 70 Timer is being used on Model GMWL - 2000, refer to timer instructions on page 13 under Model 2000 H operation step 11.

BLOWER/MOTOR REPLACEMENT PARTS GMWL-2000

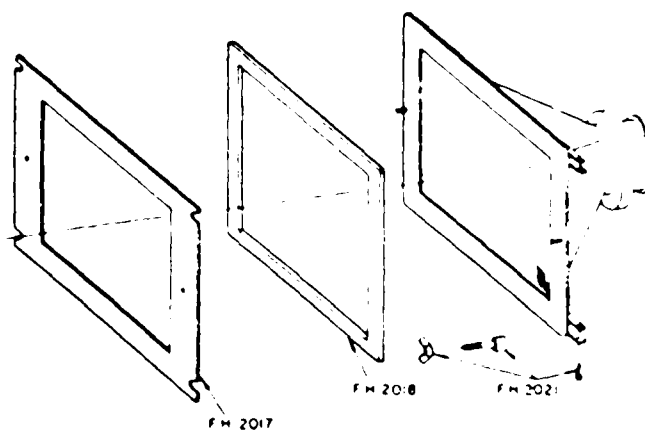
| Part No. | Description |
|----------|---|
| 2000 | Blower Motor Assembly Complete less filter holder |
| 2001 | Neoprene Gasket |
| 2002 | Mounting Plate Motor Cover |
| 2003 | Neoprene Gasket |
| 2005 | Motor Cushion |
| 115750 | 0.6 H.P. Motor |
| 215276 | Armature with Bearings |
| 2006 | Motor Mounting Ring |
| *B 1 | Motor Brushes Fer Set of Two |
| 2007 | Motor Housing |

| Part No. | Description |
|----------|--|
| 2008 | Orifice Plate |
| 2009 | Flowmeter No. 440 Graduated 10 to 70 Cubic Feet per Minute |
| 2009-M | Flowmeter Graduated 0.0 to 2.0 Cubic Meters per Minute |
| 2009-A | Flowmeter Mounting Plate |
| 2009-2 | Precision Bored Flowmeter |
| 2010 | Grommet |
| 2011 | Power Cord Assembly |
| 2012 | Assembly Bolts and Nuts |
| 2015 | Pressure Tap Assembly |
| 2016 | Tubing |

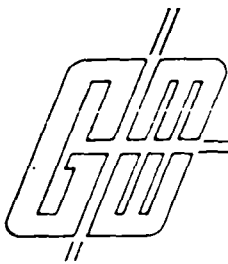


MODEL FH-2100 FILTER HOLDER

| Part No. | Description |
|----------|---------------------------|
| F.H.2100 | Filter Holder Complete |
| F.H.2017 | Aluminum Hold Down Frame |
| F.H.2018 | Rubber Gasket 8"x10" |
| F.H.2021 | WingNut & Bolt with Rivet |



* Refer to page 25



MODEL GMWL-2000 H

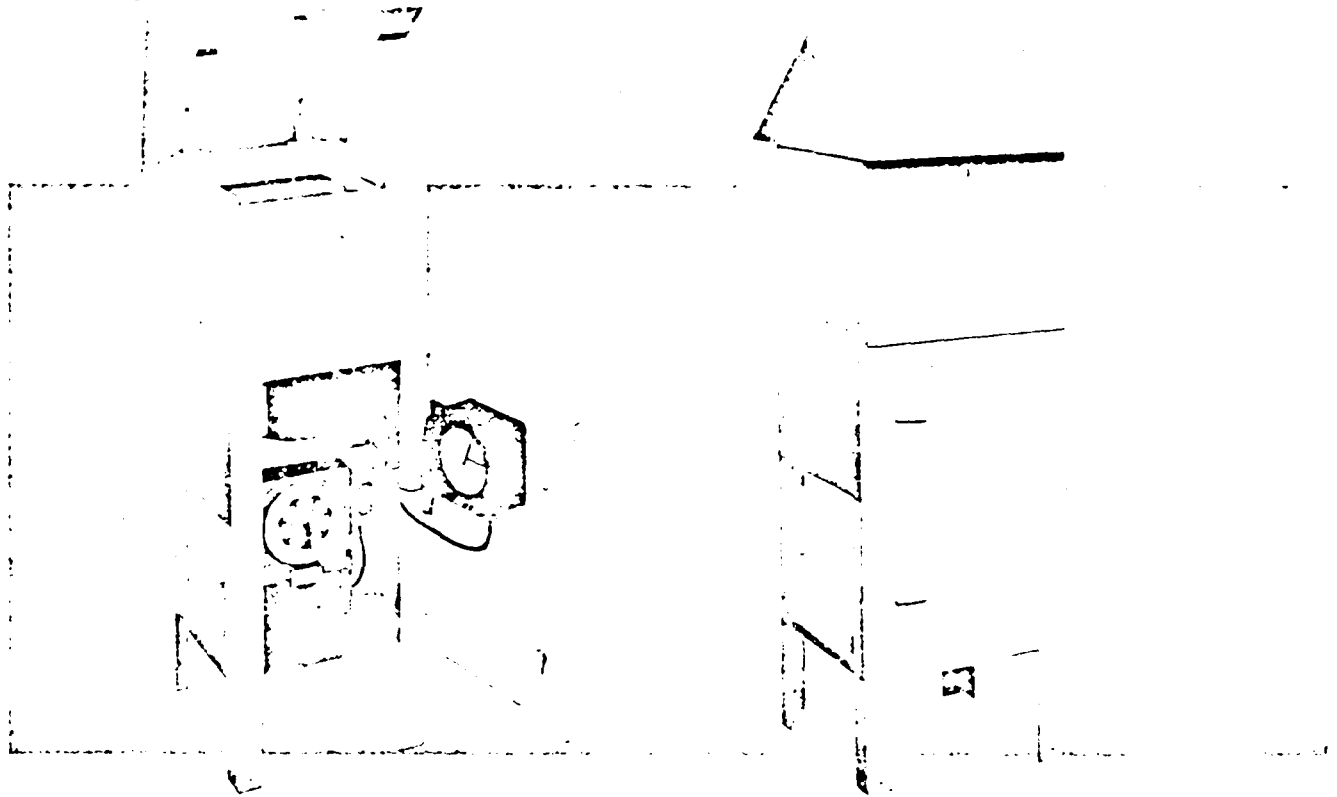
HIGH VOLUME AIR SAMPLING SYSTEM

Designed for continuous operation in an all weather environment, the Model GMWL-2000 H is a complete monitoring station for the collection of suspended particulate matter with precise measurement capability. All instruments and components are mounted within the **anodized** aluminum shelter for protection. The hinged roof facilitates filter media exchange.

The Model GMWL-2000 H is complete with high volume sampler, **seamless** stainless steel filter holder, pressure transducer recorder, 100 charts, and 90-volt protective transformer all housed in the aluminum shelter ready to operate. A seven day regular timer Model GMW-70 is included as standard equipment. The timer / programmer Model GMW-800 is optional.

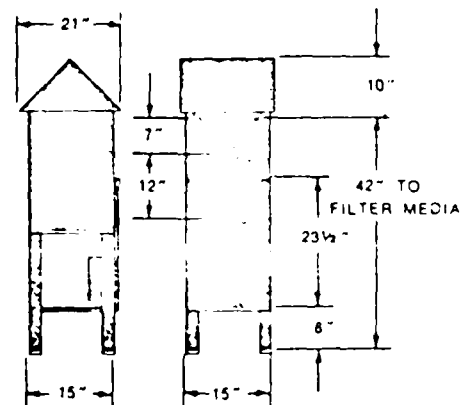
The sampler is a heavy duty turbine type blower with high speed motor arranged with a fixed orifice on the discharge end. Although factory calibrated against a water manometer, recalibration is suggested to suit barometric conditions at the site. Air flow is accurately measured by the pressure transducer which provides a permanent record of every sample.

Four bolts, easily accessible, permit motor removal for periodic brush replacement. The 90-volt transformer reduces the operating voltage to extend brush and motor life.



Specifications:

Motor HP — 0.6
 Speed — 13,500 R.P.M.
 Amperage — 4.9
 Wattage — 440
 Max. Flow Rate — 52 C.F.M.
 Min. Flow Rate — 20 C.F.M.
 Power Source — 115 V, 1 phase, 60 Hertz (other electrical characteristics available on request)
 Net Weight — 65 lbs.
 Shipping Weight — 75 lbs.
 Complies with Federal Register Vol. 36, No. 84 dated April 30, 1971



SAMPLER CALIBRATION GMWL - 2000 H

EQUIPPED WITH PRESSURE RECORDER

The high volume air sampler may be calibrated by means of a standard positive displacement rotary type meter. Although this is an accurate calibration method, it requires considerable time.

A much simpler procedure utilizes a calibrating orifice assembly and water manometer. (Model GMW - 25)
The orifice and manometer unit are factory calibrated against the positive displacement meter and a calibration curve is drawn from the air-flow versus static pressure data.

The GMW - 25 Calibration Orifice is used for calibration of the high volume air sampler and the procedure is as follows:

1. Remove the motor/blower filter holder assembly from the shelter by lifting it up and out through the rectangular hole in the support pan.
2. Remove the filter holder from the motor/blower unit and replace it with the Orifice Calibrator (GMW - 25) using the Number 18 Resistance Plate supplied with the orifice calibrator.

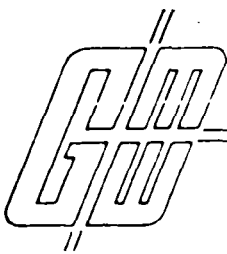
Note: Use of Calibration Adapter Plate GMW - 35 allows the operator to attach the Calibration Orifice to the motor/blower unit without the removal of the filter holder and motor/blower unit from the shelter.

3. Connect the pressure recorder to the pressure tap on the side of motor/blower unit.
4. Connect the water manometer to the pressure tap of the calibration orifice.
5. Install a clean Recorder Chart (#106).
6. Let the sampler run for five minutes.
7. Read the differential pressure as indicated by the manometer and record it on your data sheet. Convert the inches of water reading to C.F.M. using the calibration curve supplied with the calibration orifice. Record this C.F.M. figure on your data sheet. (Page 27)
8. Record the recorder chart deflection on your data sheet.
9. Change the resistance plate in the calibration orifice to the one with the next fewer number of holes (#13).
10. Turn sampler on and convert the differential pressure indicated by the manometer to the corrected flow rate.
11. Record the manometer pressure in inches of water, the actual flow rate from the calibration curve, and the recorder deflection on your data sheet.

Repeat steps 9, 10 and 11 for the remaining resistance plates.

Using the readings established with the above procedures, plot a calibration curve representing the actual flow rate versus the recorder deflection. (Page 27)

This new calibration curve is used as a direct reference to obtain the actual flow rate.



SAMPLER OPERATION GMWL - 2000 H

1. Place sampler and filter holder in the servicing position by raising both the sampler motor/blower unit and filter holder up until the filter holder is above the top level of the shelter. Then rotate the unit one-quarter turn so that the filter holder hangs in the rectangular hole in the sampler support pan.
2. Remove faceplate by loosening the four wing nuts allowing the swing bolts to swing down out of the way.
3. Carefully center a new filter, rougher side up, on the supporting screen. Properly align the filter on the screen so that when the faceplate is in position the gasket will form an airtight seal on the outer edges of the filter.
4. Secure the filter with the faceplate and four brass swing bolts with sufficient pressure to avoid air leakage at the edges.
5. Rotate and lower the filter holder and blower/mower assembly to its normal operating position.
6. Wipe any dirt accumulation from around the filter holder with a clean cloth.
7. Close lid carefully and secure with the aluminum strip or padlock.
8. Plug all cords into their appropriate receptacles as follows:
 - A. Motor/blower unit male to transformer female.
 - B. Transformer male to timer female (left female cord set).
 - C. Recorder transducer male to timer female (right hand cord set).
 - D. Regular Timer GMW - 70 male to 115V., 60Hz. source (if timer is being used.)

If the GMW-800 Timer/Programmer is used, then modify procedure as follows:

- A. Motor/blower unit male to transformer female.
 - B. Transformer male to timer/programmer female (left hand cord set.)
 - C. Recorder transducer male to timer/programmer female (right hand cord set.)
 - D. Timer/Programmer male to 115V. 60 Hz. source.
9. Connect rubber tubing between the pressure tap on the sampler and the connector on the bottom of the recorder transducer. Be careful not to pinch tubing when closing shelter door.

10. Prepare Recorder Transducer as follows:

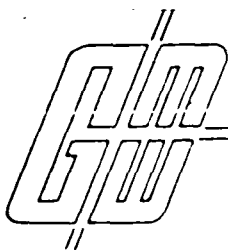
- A. Clean any excess ink and moisture on the inside of recorder by wiping with a clean cloth.
- B. Depress pen arm lifter to raise pen point and carefully insert a fresh chart in the recorder.
- C. Carefully align the center tab of the chart to the drive hub of the recorder and press gently with thumb to lower chart center onto hub. Make sure chart is placed under the chart guide clip and the time index clip so it will rotate freely without binding.
- D. With the pen arm lifter depressed, fill pen point reservoir with the ink provided. Place ink bottle nipple squarely against pen point reservoir and squeeze gently. Release pen arm lifter and let the pen point fall to the fresh chart. Move the pen arm laterally a few times to make sure the pen point will ink during the sampling period.

NOTE: On recorders supplied with a felt tip pen cartridge (GMW 127) make sure that the pen point rests on the chart with sufficient pressure to make a visible trace.

11. Prepare the GMW-70 timer as follows:

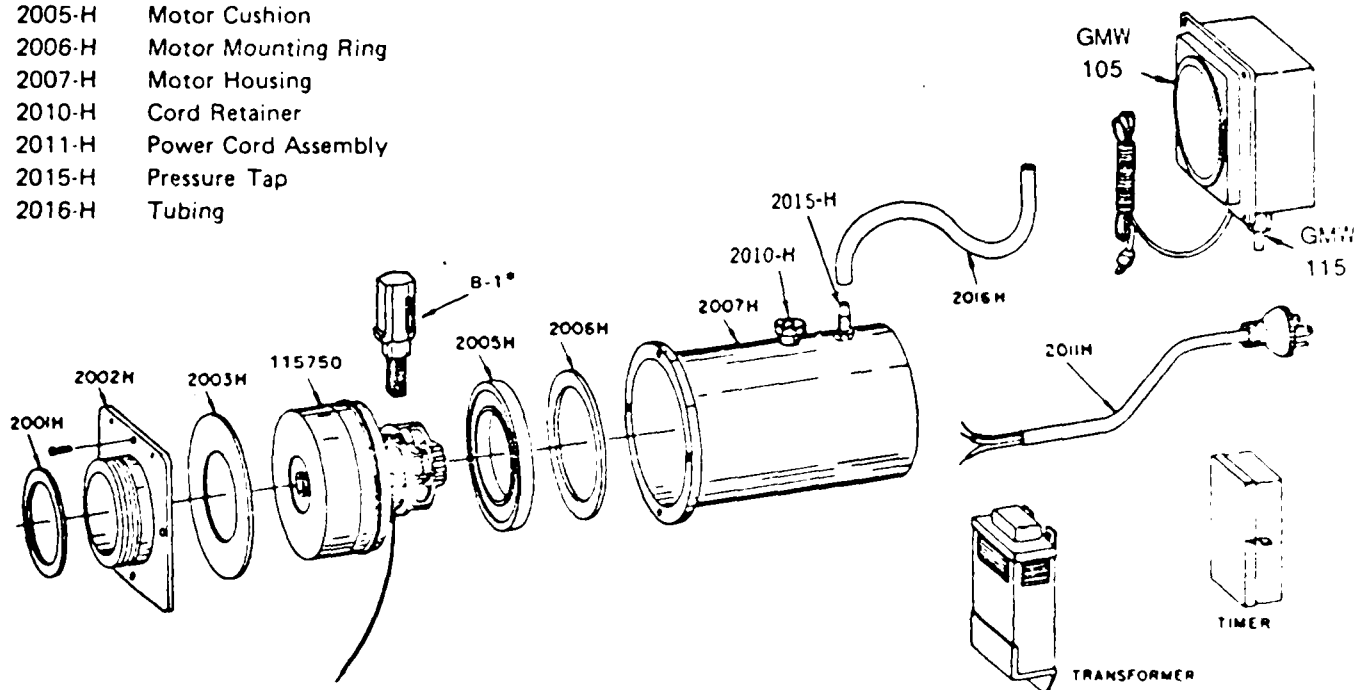
- A. To set the "on" time, place an "A" (bright) tripper on the dial face.
- B. To set the "off" time place a "B" (dark) tripper on the dial face.
- C. Trippers must be tight against dial rim. Tighten tripper screws with fingers only.
- D. To set time grasp dial and rotate clockwise only until correct day and time of day appear at time pointer.

- 12. Manually trip timer switch on to determine if sampler is operating properly and the recorder is inking correctly.
- 13. When it has been determined the unit is operating properly, turn unit off, reset timer, close timer door, close recorder door, and close shelter door being careful not to pinch the recorder tubing.
- 14. At the end of the sampling period place the sampler motor/blower filter holder assembly in the service position.
- 15. Remove the face plate to expose the filter. Carefully remove the exposed filter from the supporting screen by holding it gently at the ends (not at the corners). Fold the filter lengthwise so that sample touches sample.



BLOWER/MOTOR REPLACEMENT PARTS GMWL-2000 H

| Part No. | Description |
|----------|--|
| 2000H | Blower/Motor Assembly Complete less filter holder |
| 2001-H | Neoprene Gasket |
| 2002-H | Mounting Plate Motor Cover |
| 2003-H | Neoprene Gasket |
| 115750 | 0.6 H.P. Motor |
| *B-1 | Motor Brushes — Two Per Set |
| 215276 | Armature with bearings |
| 2005-H | Motor Cushion |
| 2006-H | Motor Mounting Ring |
| 2007-H | Motor Housing |
| 2010-H | Cord Retainer |
| 2011-H | Power Cord Assembly |
| 2015-H | Pressure Tap |
| 2016-H | Tubing |



RECORDER REPLACEMENT PARTS

| Part No. | Description |
|----------|--|
| GMW-105 | Complete recorder unit with 100 charts and cartridge pen point |
| GMW-106 | Charts for Recorder (CFM) |
| GMW-107 | Recorder Ink |
| GMW-108 | Recorder Chart Motor (115V., 60Hz., 1Ph) |
| GMW-110 | "V" Pen Point |

| | |
|---------|---------------------|
| GMW-113 | Door Gasket |
| GMW-115 | Hose Fitting |
| GMW-120 | Pen Arm for "V" pen |
| GMW-123 | Back Gasket |
| GMW-124 | Pen Arm Lifter |
| GMW-126 | Cartridge Pen Arm |
| GMW-127 | Cartridge Pen Point |

* Refer to page 25

MODEL GMW-800 SIXTH DAY TIMER/PROGRAMMER OPERATING INSTRUCTIONS

The model GMW-800 timer/programmer provides three distinct programming modes, 24 hour, episode and sixth day sampling. For all modes the real time clocks "A&B" are set to the actual time of day.

The white "ON" and the black "OFF" tabs of clock "A" are set at midnight. The function of clock "A" is to sequentially advance the indicator light every 24 hrs. Thus while passing through three switch positions or days with only the second day switch in the up position will give a 24 hour sampling period.

NOTE: The ON and OFF tabs of clock "A" are secured together under the clock face and must be moved together. The OFF tab of clock "A" must never be permitted to swing around in front of the ON tab. This will result in a burn out of the stepping mechanism coil.

The ON and OFF tabs of clock "B" are needed only while in the episode sampling mode. The function of clock "B" is to act as a series switch to the output according to the setting of the ON and OFF tabs on the face of clock "B".

NOTE: By placing the toggle switch between clocks "A" and "B", in the right hand position, allows the series switch of clock "B" into the circuit.

Both clocks rotate together clockwise with the up position of the power switch.

The indicator lights are wired in parallel and indicate the day or position of the stepping mechanism. As a result it is possible for more than one indicator light to light up when the timer output is activated. To reset the indicator light all seven day switches must be in the down position.

This timer is arranged with three cord sets extending down from the bottom of the timer. The male cord set is plugged into the source voltage (115V., 60 Hz). The left hand female cord set is the timed output. The right hand female cord set is an auxiliary output which is not timed.

24 HOUR SAMPLING

With all seven day switches and the 6TH DAY SAMPLE switch in the DOWN position, reset the indicator light to the present day by sequentially pressing the DAY RESET switch. The toggle switch between clocks "A" and "B" is set in the left hand position. The desired sampling day switches are placed in the UPWARD position. The sampling period is from midnight to midnight.

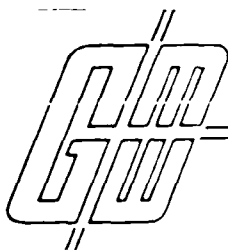
EPISODE SAMPLING

With all seven day switches and the 6TH DAY SAMPLE switch in the DOWN position, reset the indicator light to the present day by sequentially pressing the DAY RESET switch. The toggle switch between clocks "A" and "B" is set in the right hand position. The desired sampling day switches are placed in the UPWARD position. The ON and OFF tabs on clock "B" can then be set for any sampling period within 24 hours.

SIXTH DAY SAMPLING

NOTE: When in the sixth day sampling mode disregard day of the week nomenclature. The days of the week should be regarded as positions and not Monday, Tuesday, etc.

With all seven day switches in the DOWN position, reset the indicator light to the fifth from the left position (Thursday) by sequentially pressing the DAY RESET switch. Place the 6TH DAY SAMPLE switch and the sixth from the left day switch (Friday) in the UP position. Set the toggle switch between clocks "A" and "B" to the left hand position. The sampling period is from midnight to midnight the following day or position and every six days thereafter.



MODEL GMWS - 2310 ACCU-VOL[®]

A complete air sampling system, ACCU-VOL (Model GMWS-2310) features accurate collection of suspended particulates exceeding EPA specifications. Air flow through the system is maintained at a constant rate by an electronic probe which automatically adjusts the speed of the sampler to correct for variations in line voltage, temperature, pressure and filter loading.

Adjustable over a range from 20 SCFM to 60 SCFM,* the air flow is controlled at constant standard conditions of 25°C temperature and 760 mm HG pressure within plus or minus 1 SCFM. By maintaining an exact air flow rate through the sampler, the average concentration measured is extremely accurate and reliable. In addition, calculations and corrections for ambient temperature and barometric pressure changes are unnecessary.

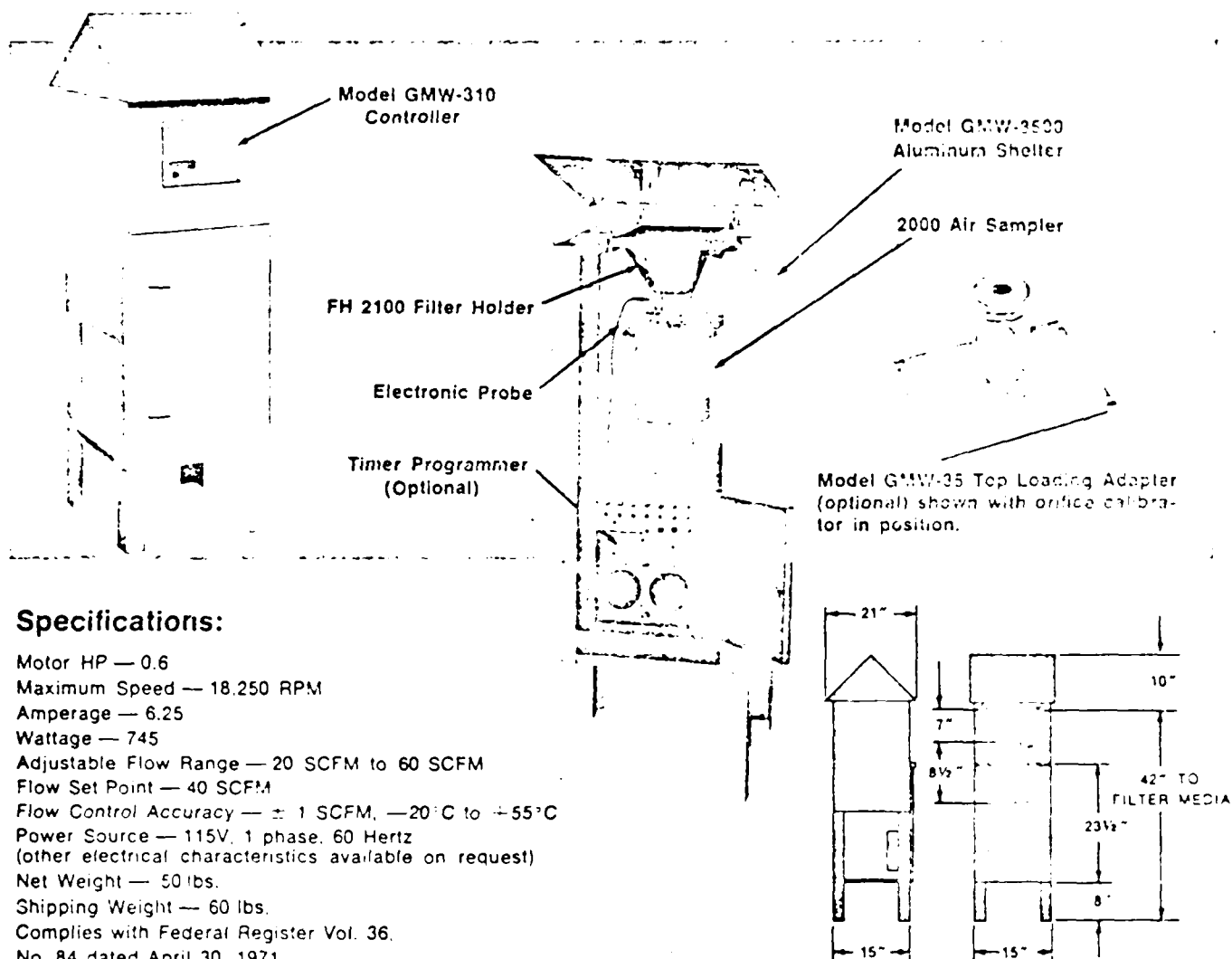
The high volume air sampler, regulated by the controller, operates at the lowest possible speed necessary to sustain the desired air flow rate. As a result, motor and motor brush life are extended due to the reduced speed and operating voltage.

The ACCU-VOL simplifies all phases of the sampling process. Initial calibration requires no disassembly of the system and once calibrated needs no further attention except on the routine basis of approximately every 1000 hours.

Flow rate measurements before and after sampling are also unnecessary. The ACCU-VOL eliminates conversion calculations, chart reading and corrections while achieving the ultimate in accurate particulate measurement.

MODEL GMW-35 TOP LOADING ADAPTER

Used in conjunction with Calibration Kit GMW-25, the top loading adapter mounts directly on the filter holder facilitating periodic sampler calibration. The adapter is threaded to accept only the aluminum orifice calibrator affording precise sampler calibration without disassembly. Priced separately, it is especially recommended for calibrating the Accu-Vol system.



Specifications:

Motor HP — 0.6
Maximum Speed — 18,250 RPM
Amperage — 6.25
Wattage — 745
Adjustable Flow Range — 20 SCFM to 60 SCFM
Flow Set Point — 40 SCFM
Flow Control Accuracy — ± 1 SCFM, -20°C to $+55^{\circ}\text{C}$
Power Source — 115V, 1 phase, 60 Hertz
(other electrical characteristics available on request)
Net Weight — 50 lbs.
Shipping Weight — 60 lbs.
Complies with Federal Register Vol. 36,
No. 84 dated April 30, 1971

*SCFM — Standard Cubic Feet per Minute as defined in Fed. Reg. Vol. 36, No. 84 dated April 30, 1971, Chapter IV, Title 42 Article 410.3 Reference Conditions

SAMPLER CALIBRATION GMWS - 2310 ACCU-VOL®

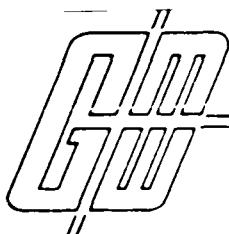
In order to establish and set up the selected flow rate for the high volume air sampler, it is necessary that the system be properly calibrated. This calibration is performed with an orifice calibrator as specified for the EPA High Volume Method. However, unlike the method required for high vols not equipped with the model GMW-310 controller, one calibration point need only be established since the Accu-Vol has excellent long term calibration stability. Once the prescribed flow rate has been set, it will maintain this standard flow rate independent of changes in barometric pressure, ambient temperature, line voltage and filter loading.

The recommended method for calibrating the system is to use the GMW-25 calibration kit and the GMW-35 top loading adapter plate.

1. Place a standard 8" x 10" filter paper on the filter holder and secure it with the GMW-35 top loading adapter plate.
2. Attach to the adapter plate the orifice calibrator, GMW-25.
3. Connect a hose between the pressure tap on the calibrating orifice and a suitable water manometer, (zero manometer if necessary).
4. Activate the Accu-Vol and allow system to warm up for five minutes.
5. Open access door to the electronics package and locate control potentiometer.
6. Adjust the control potentiometer clockwise to increase flow and counter-clockwise to decrease flow.

(Note: This is a several turn potentiometer).
7. Use the control potentiometer to obtain the desired flow rate. 40 SCFM is the recommended set point.
8. It is not necessary to recalibrate the Accu-Vol sampler after the motor brushes or the motor are replaced.

NOTE! Accu-Vol systems equipped with a pressure recorder (Accu Vol Model GMWS-2310-105) are calibrated as above except the pressure recorder is utilized instead of the flowmeter.



CONVERTING EXISTING HI-VOLS TO OPERATE AS AN ACCU-VOL

The model GMW-310 Flow Controller consists of a flow probe and electronics package. The electronics package is bolted to the shelter of the sampler system and the flow probe is inserted into the filter holder. It is recommended that the electronics package be mounted inside of the shelter, preferably on the inside of the door for ease of access. Placement is not critical as long as the flow probe cable can conveniently reach the filter holder.

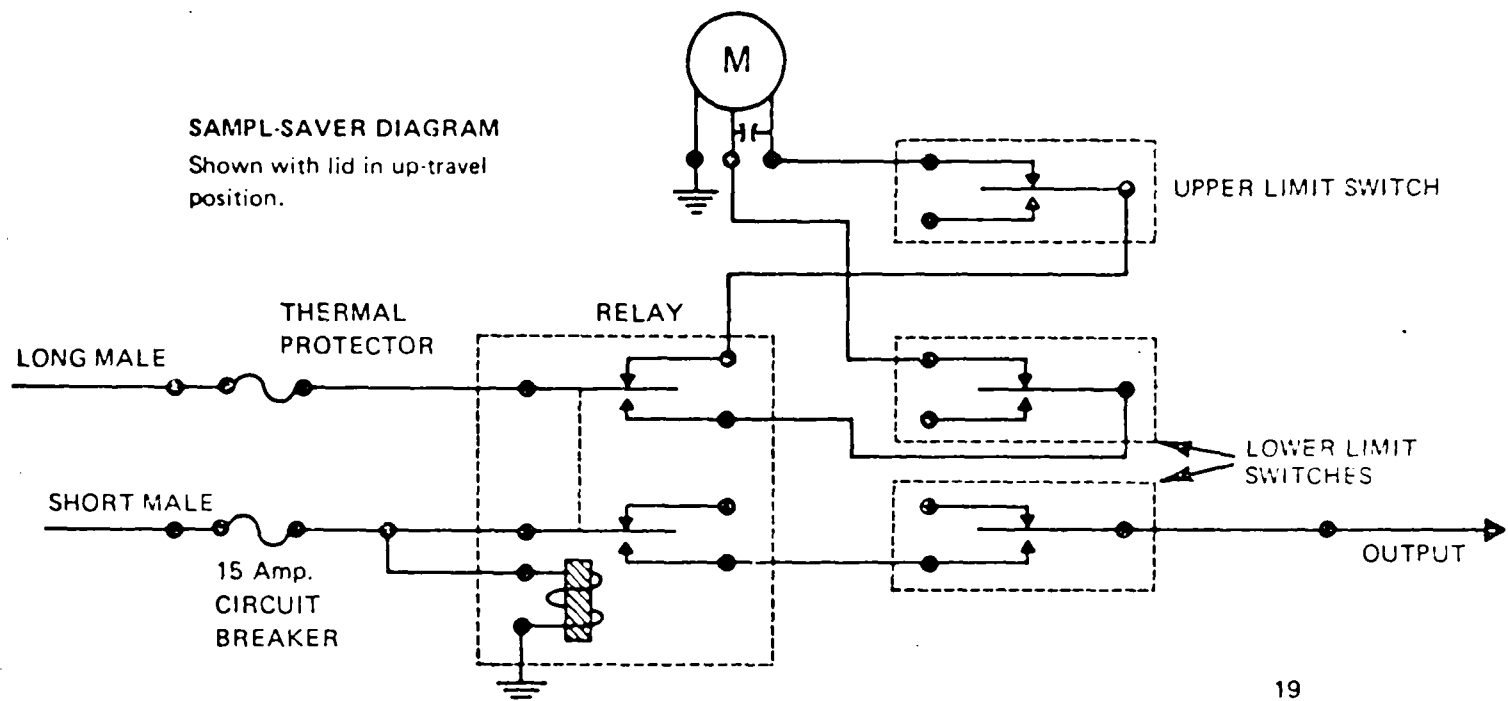
1. Drill four (4) 7/32" diameter holes through the door of the shelter using the electronics package as the template for hole locations. Make certain that when installed, the door will close.
2. The flow probe is installed in the throat section of the filter holder and secured with the stainless steel worm gear hose clamp.
3. Drill a 17/64" hole in the straight portion of the filter holder throat 3/4" below the point of transition between the straight section and expanded portion of the filter holder.
4. Fasten filter holder to the blower/motor as usual.
5. Place filter holder/motor assembly into rectangular hole in the shelter top support pan and rotate about 45° such that the flange of motor assembly rests in the rectangular hole to allow space to bring the flow probe up through hole.
6. Bring the flow probe up through inside of shelter and rectangular hole.
7. Open hose clamp; then remove the protective cover on the tip of probe.
8. Slide hose clamp around the filter holder neck and simultaneously slide flow probe into drilled hole.
9. Look through screen of filter holder and rotate the probe such that the sensor portion is facing directly into the air flow (slot is vertical).
10. Tighten hose clamp to secure probe in that position.
11. Being careful not to pinch the probe cable, lower the filter holder and blower/motor assembly down into the shelter to its normal operating position.

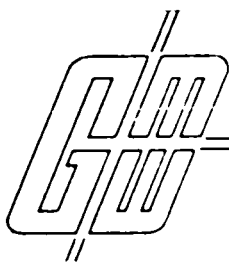
GMW-8550 SAMPL-SAVER™ (PAT. #4235098)

1. Install the GMW-8550 Sampl-Saver in the GMW-8500 aluminum shelter. First remove the sampler support pan. Then insert the Sampl-Saver making sure that the Sampl-Saver door slot is placed to the rear of the shelter near the hinges. Shelter lid hinge plates must be placed on the "OUTSIDE" of the shelter top. (See Shelter Assembly - Step 6 - Page 4)
2. Connect the Sampl-Saver female cord set to the blower motor.
CAUTION: If any transformers or flow controllers are used, they must be connected between this female cord set and blower/motor.
3. Connect the short male cord to the timer or if a timer is not used, connect to the power source.
4. Connect the long male cord set to any constant power source.
5. To raise lid, energize only long male cord set.
6. To lower lid, energize both long and short male cord sets.
7. The closed position (lid covering filter area) is factory adjusted to approximate the height of a filter holder (F.H.2100) installed with a filter paper cartridge (GMW-3000).
8. "Travel adjustment screw" is located in the rear left hand corner of the Sampl-Saver.
9. Turn the "Travel adjustment screw" clockwise for more "up-travel".
10. Turn the "Travel adjustment screw" counter-clockwise to limit the "up-travel".
CAUTION: To limit the up-travel, the lid must be retracted (lid moving down inside of Sampl-Saver). Then adjust the "Travel adjustment screw" counter-clockwise about 10 full turns. Recheck up-travel.
11. The closed position should be checked after every filter change because of wing nut pressure and or difference in gasket thickness.

SAMPL-SAVER DIAGRAM

Shown with lid in up-travel position.





PORTABLE AIR SAMPLERS

TRIPOD GMWT 2200

The GMWT-2200 Tripod Hi-Vol is especially suited for line sampling verification or compliance measurements requiring frequent relocation from site to site. As these measurements are usually of short duration, timers, programmers, recorders, etc., are not required.

The unit provides complete portability yet incorporates standard size components utilized in stationary models including standard 8" x 10" filter media. The tripod legs are removable to facilitate transporting.

An integral orifice meter with dual pressure taps is located in the throat of the filter holder. Flow rate is measured by manometer readings taken across the orifice meter.

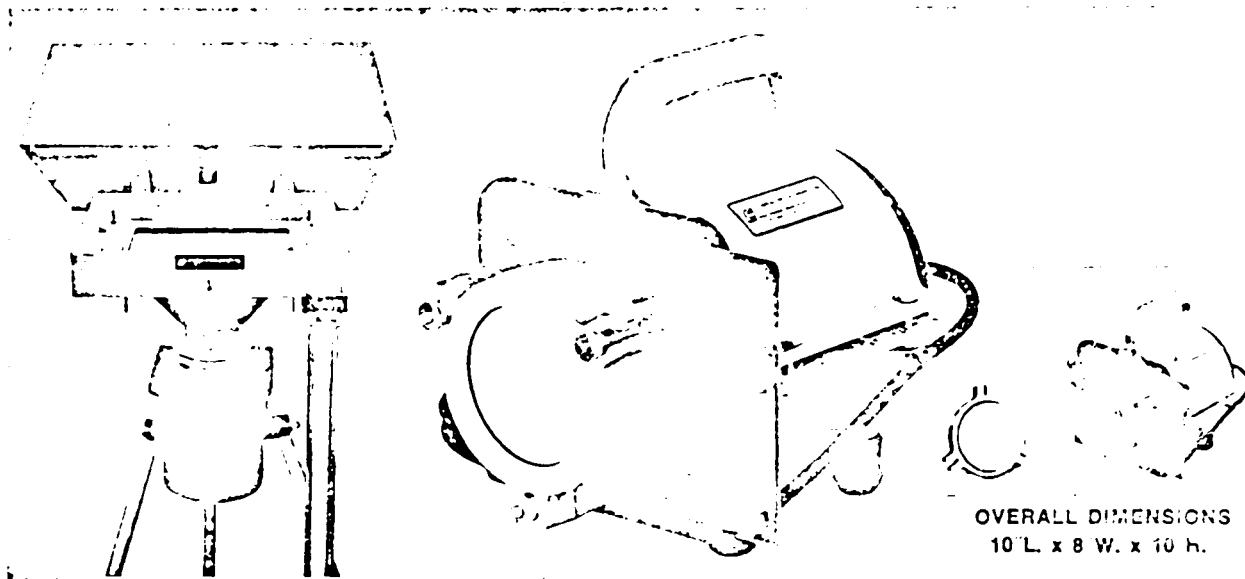
The unit consists of a model GMWL-2000 sampler complete with an FH-2100 seamless stainless steel filter holder. The filter holder bolts to the underside of the shelter roof support. The gable style roof is hinged to facilitate filter paper replacement.

HANDI-VOL 2000 T.M.

The Handi-Vol 2000 features a rugged, compact "sample anywhere" design for determining airborne particulate levels in isolated areas. It is ideally suited to intermittent verification of industrial hygiene standards and suspected pollution sources. Utilizing 4" diameter paper (8" x 10" filter optional) of various types, the unit traps particles to .01 microns.

The filter holder is closely coupled to the blower motor to minimize overhang and provide maximum protection to the sample taken. The "swing away" bolts on the filter holder facilitate paper replacement and eliminate damage to the filter media while clamping. The filter support screen is equipped with an "O" ring gasket providing a leakproof seal during the sampling process.

The Handi-Vol 2000 is equipped with a variable orifice meter for measuring air flow rate. The sampler unit is assembled ready for operation with 4" diameter filter holder, flowmeter, integral handle, rubber tipped feet and polarized electrical cord with off-on switch.



Specifications—Tripod & Handi-Vol:

Motor HP — 0.6

Speed — 18,250 RPM

Amperage — 6.25

Wattage — 745

Tripod Flow Rate 8" x 10" filter — 20 CFM to 60 CFM

Handi-Vol Flow Rate 4" Dia. filter — 15 CFM to 20 CFM

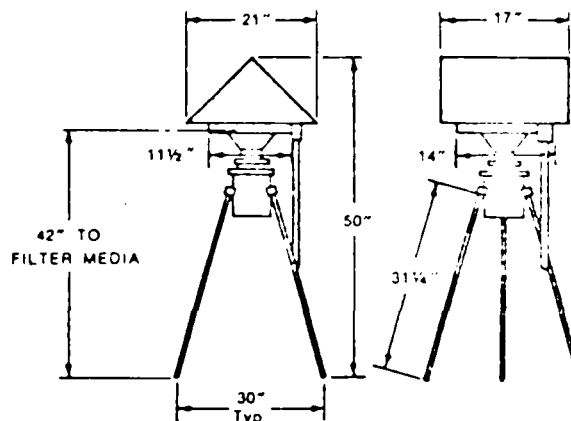
Power Source — 115V, 1 phase, 60 Hertz (other electrical characteristics available on request)

Net Weight: Tripod — 34 lbs., Handi-Vol — 13½ lbs.

Shipping Weight: Tripod — 40 lbs., Handi-Vol — 16 lbs.

Complies with Federal Register Vol. 36,

No. 84 dated April 30, 1971



TRIPOD GMWT 2200 • SELF-CONTAINED HI-VOL

Assembly

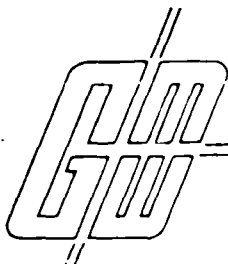
1. Insert the three round aluminum legs into the adapter ring and secure with thumb screws.
2. Assemble the blower/motor and filter holder with the orifice meter plate in place between them.
3. Lower the blower/motor and filter holder assembly into the adapter ring.
4. Attach the shelter lid to the rear of the shelter body.
5. Install the lid latch to the front of the shelter body.
6. The water manometer should be located in a hanging position on the front of the shelter body.
7. Attach each leg of the water manometer to the two pressure taps on the blower/motor and filter holder.
8. Fill water manometer as prescribed on page 5.

Calibration

1. Remove the filter hold down frame from filter holder.
2. Attach a GMW-35 Top Loading Adapter Plate to the filter holder.
3. Install the GMW-25 calibration orifice with the appropriate load plate (number 18 hole plate) onto the top loading adapter plate.
4. Connect a water manometer to the calibration orifice.
5. Plug blower/motor into a 115V., 60Hz. power source.
6. Read the manometer attached to the calibration orifice and convert to actual flow rate using the curve supplied with that orifice.
7. Read the manometer attached to the blower/motor/filter holder assembly.
8. Record the actual flow rate and the differential pressure figure that was obtained from the manometer attached to the blower/motor/filter holder on the data sheet. (page 27)
9. Use the remaining load plates (using the plate with the next fewer number of holes next) until the actual flow rates and differential pressures have been established.
10. Using the readings established with the procedure above, plot a curve which will represent the actual versus indicated flow rates.
11. This new calibration curve is used as a direct reference to obtain the actual flow rate in the field.

Sampler Operation

1. Remove the filter hold down frame by loosening the four wing nuts allowing the swing bolts to swing out of the way.
2. Carefully center a new filter (GMW-810) rougher side up, on the supporting screen.
3. Properly align the filter on the screen so that when the face plate is in position the gasket will form an airtight seal on the outer edges of the filter.
4. Fasten the filter hold down frame to the filter holder with the swing bolts and secure with wing nuts with sufficient pressure to avoid air leakage at the edges.
5. Close shelter lid carefully and secure catch with the aluminum strip.
6. Plug blower/motor unit into a 115V., 60Hz. power source and allow sampler to stabilize before taking the initial pressure reading from the manometer.
7. Flow measurements are taken at the beginning and at the end of the sampling period.



HANDI-VOL 2000™ • SELF-CONTAINED HI-VOL

The Handi-Vol 2000 is especially designed for intermittent verification and determination of airborne particulate levels. The filter holder is closely coupled to the blower/motor to minimize overhang and provide maximum protection to the sample taken. The "swing away" bolts on the filter holder facilitate paper replacement and eliminate damage to the filter media while clamping.

The Handi-Vol 2000 is shipped fully assembled and ready to operate. Instruments are always shipped uncalibrated. This procedure must be performed by the operator.

Calibration (standard 5 plate)

Each new Handi-Vol must be individually calibrated prior to its use. Any repairs to the motor or suspected damage necessitates recalibration. Monthly calibration checks are recommended. Equipment required to perform a calibration:

- calibrator orifice w/calibration curve (GMW-25)
- set of resistance plates
- water manometer
- graph paper

Procedure

1. Install the resistance plate (perforated disc) with the most number of holes in place of the 4" filter holder and secure it with the calibration orifice.
2. Connect the water manometer to the pressure tap on the calibration orifice. Make sure the manometer has sufficient water and is level with zero marks.
3. After making sure all fittings are tight and leak free, connect the line cord to a 115V., 60Hz. power source.
4. Let the blower/motor stabilize for a minute or so before taking a manometer reading.
5. Read the manometer in inches of water (add both sides) and enter this figure on the data sheet under "True H₂O".
6. With this "True H₂O" figure, establish an Actual CFM from the orifice calibration curve. Enter this on data sheet.
7. With sampler running, adjust the flowmeter to this actual CFM figure. Loosen lock nut and adjust ball float to its middle with the reading obtained in step "6". When adjustment is made, tighten the locking nut making sure that the float does not move.
8. Complete the calibration of the Handi-Vol using the remaining resistance plates (with successively smaller amount of holes, more resistance/less flow). Use only one plate at a time.
9. With the readings established, plot a curve which will represent the actual flow rate versus the flowmeter readings.
10. This new calibration curve is used as a direct reference to obtain the actual flow rate.

NOTE! It is recommended that the Handi-Vol be calibrated with seven (7) resistance plates, two of which are lower in the number of holes than the normal set of plates used with Hi-Vols. These additional plates will produce two points lower on the reference curve to insure good curve extrapolation. (Example — plate nos. 18-13-10-7-5-3-2)

Maintenance:

The motor brushes in a Handi-Vol have an uncommonly high wear rate and must be checked occasionally depending upon use. This is due to the heat which is generated by the low air flow across this flow-thru motor.

Brush replacement

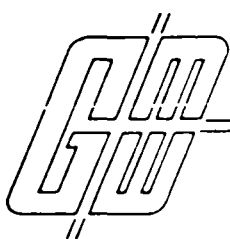
1. Remove the mounting plate motor cover (PN-2002) by removing the four ¼-20 bolts.
2. Slide the power cord through the rubber grommet toward the motor and let the motor slip from the housing.
3. Replace the worn brushes. (See page 24.)
4. After reassembly, the new brush set must be seated to the armature to achieve best performance.
5. Apply approximately 50% voltage for thirty (30) minutes to accomplish this seating. The armature and brushes should not arc and spark excessively. If so replace the armature.
CAUTION: Direct application of full voltage after changing brushes might cause arcing, commutator pitting and reduce overall life. Brushes should be changed before the brush shunt or wire (inside brush carbon) touches the commutator.

Sampling

Caution should be used when sampling with the Handi-Vol sampler. It has a flow/thru type motor which depends on the air flow for cooling. Only sample long enough to obtain a representative amount of particulate on the filter.

Sampling Procedure

1. Install a clean filter in the filter holder. Release toggle bolts and remove hold down ring. Place a clean filter on the support screen and center it. Replace the hold down ring and secure it with the toggle bolts.
2. Start sampler and allow it to warm up for a minute or so.
3. Record the flowmeter reading and find the true CFM figure from the reference curve (see Calibration section, step 4). It is suggested that a copy of the reference curve be carried with each individual sampler.
4. At the end of the sampling period record the final flow reading.



MOTOR BRUSH REPLACEMENT

ALL MODELS EXCEPT MODEL GMWL - 2000 H

1. Remove Orifice Plate (part # 2008) from sampler by removing four 6-32 bolts and nuts. Slide power cord through the rubber grommet to gain access to brushes.
2. Remove the brush holder clamp and release the expended brush.
3. Release the quick disconnect tab (on all motors after Jan. 1, 1978) from the brass sleeve of the expended brush and mount it on a new brush.
4. Place the new brush in the motor casting so as to register on the boss of the casting.
5. Replace brush holder clamp on the brush and secure to motor with the screws.
6. Use the procedure as defined above for the other brush.
7. The model 115750 motor (sold after Jan. 1, 1978) has as standard equipment the quick disconnect tab. The 115750 motor uses the # B-1 brush set. The B-3 brush set will be available only for parts replacement on existing motors in the field. (Model 115250)

MODEL GMWL - 2000 H

1. Remove the mounting plate motor cover (part # 2002-H) by removing the four hex-head bolts. This will expose the motor.
2. Release the power cord by turning the cap of the power cord connector (part # 2010-H) counter-clockwise.
3. Carefully let the motor slide from the housing exposing brushes.
4. Remove the brush holder clamp and release the expended brush.
5. Register new brush and replace brush holder clamp and secure to motor with the screws.
6. Assemble motor after brush replacement by placing the housing over and down on the motor, being careful not to pinch any motor wires beneath the motor Mounting Ring (part # 2006-H).
7. Replace the mounting plate motor cover.
8. Gently pull the power cord back out of sampler housing and secure it with the connector cap.

MOTOR BRUSH SEATING PROCEDURE

On reassembly and handling, the lead wires must be kept away from rotating parts and motor frame.

To achieve best performance, the new brushes should be seated on the commutator before full voltage is applied.

After brush change apply approximately 50% voltage for thirty minutes to accomplish this seating. The motor will return to full performance after thirty to forty-five minutes running at full voltage.

(Caution) – Direct application of full voltage after changing brush will cause arcing, commutator pitting, and reduce overall life.

Use of the Model GMW - 900 Voltage Variator provides the reduced voltage needed for brush seating.

If reduced voltage is unavailable, connect two motors of similar rating in series for thirty minutes to accomplish the brush seating.

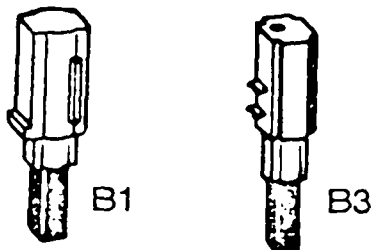
WARNING – **THE BRUSHES SHOULD BE CHANGED BEFORE**
THE BRUSH SHUNT TOUCHES THE COMMUTATOR.

SPECIAL NOTE: When ordering GMW Replacement Motor Brushes, compare brush configuration carefully!

B-1 Brush Sets used on 115750 motors furnished after January 1978

B-3 Brush Sets used on 115250 motors furnished prior to January 1978 only.

Motor Brush "U" clip connectors used with B-3 brush sets only.



CALIBRATION DATA SHEET **HIGH VOLUME AIR SAMPLER CALIBRATION**

Unit No.: _____

Date: _____

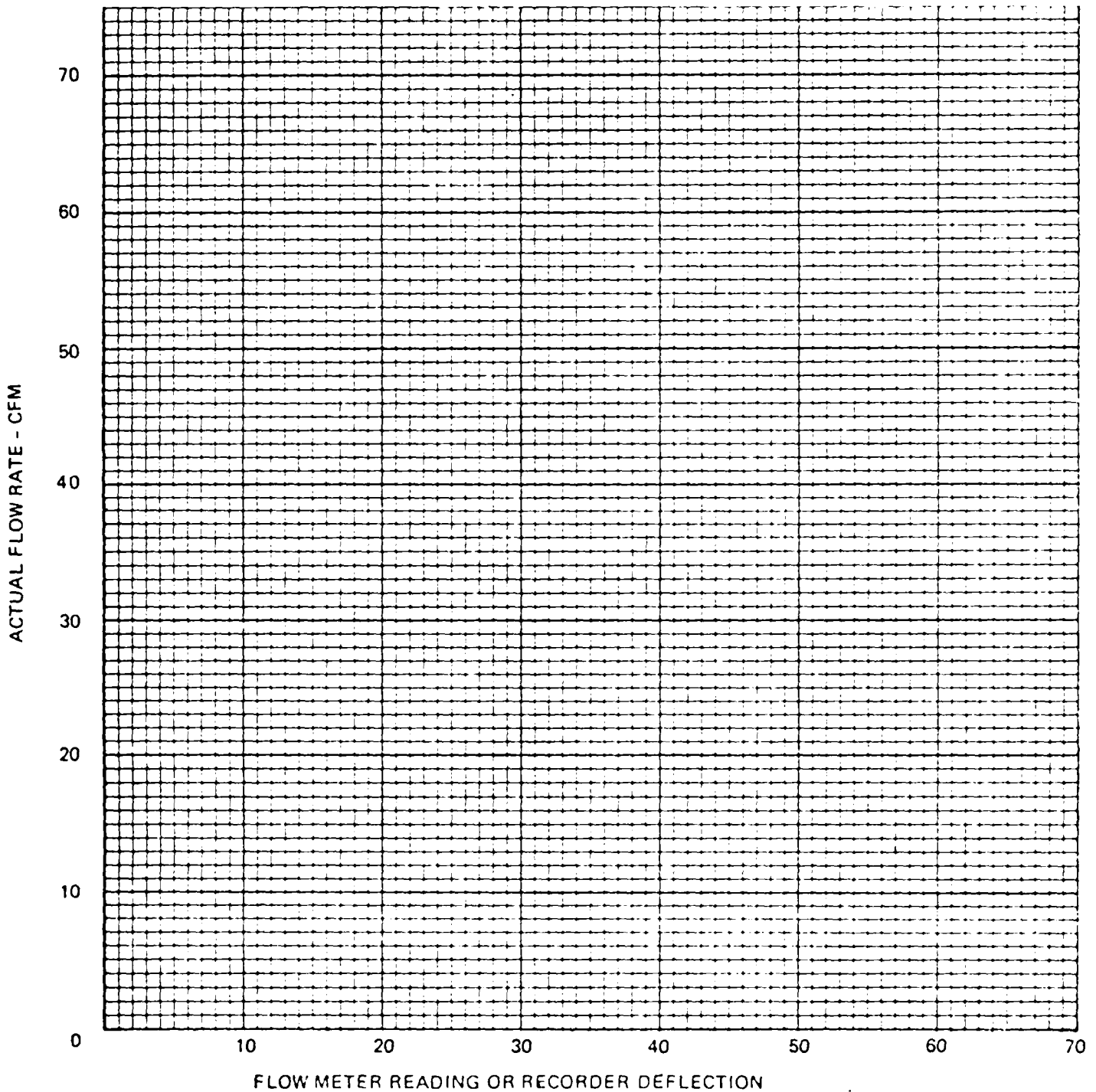
By: _____

Temp.: _____

At. Press: _____

Remarks: _____

| Plate | Indicated | True "H ₂ O | Actual cfm |
|-------|-----------|---------------------------|---------------|
| 18 | | | |
| 13 | | | |
| 10 | | | |
| 7 | | | |
| 5 | | | |
| | | | |
| | | | |



FIELD AUDIT CHECKLIST

Field Observations

PROJECT NO. _____ DATE OF AUDIT _____

PROJECT MANAGER _____ SIGNATURE OF AUDITOR _____

OFFICE LOCATION _____

Yes ___ No ___ N/A ___ 1. Was permission granted to enter and inspect the facility?

Comments: _____

Yes ___ No ___ N/A ___ 2. Is permission to enter the facility documented?

Comments: _____

Yes ___ No ___ N/A ___ 3. Were split samples offered to the facility?
If yes, was the offer accepted or declined?

Comments: _____

Yes ___ No ___ N/A ___ 4. If the offer to split samples was accepted, were the split samples collected?

Comments: _____

Yes ___ No ___ N/A ___ 5. Is the offering of split samples recorded?

Comments: _____

Yes ___ No ___ N/A ___ 6. If split samples were collected, are they documented?
If yes, where are they documented?
Comments: _____

Yes ___ No ___ N/A ___ 7. Are the number, frequency, and types of field measurements and observations taken as specified in the project plan or as directed by the SPM?
Comments: _____

Yes ___ No ___ N/A ___ 8. Are field measurements recorded (pH, temperature, conductivity, etc.)? Where?
Comments: _____

Yes ___ No ___ N/A ___ 9. Are samples collected in the types of containers specified in the project plan or as directed by the SPM?
Comments: _____

Yes ___ No ___ N/A ___ 10. Are samples preserved as specified in the Project Plan or as directed by the SPM?
Comments: _____

Yes ___ No ___ N/A ___ 11. Are the number, frequency, and types of samples collected as specified in the Project Plan or as directed by the SPM?

Comments: _____

Yes ___ No ___ N/A ___ 12. Are samples packed for preservation as specified in the Project Plan (i.e., packed in ice, etc.)?

Comments: _____

Yes ___ No ___ N/A ___ 13. Is sample custody maintained at all times?

Comments: _____

FIELD AUDIT CHECKLIST

Document Control

PROJECT NO. _____ DATE OF AUDIT _____
PROJECT MANAGER _____ SIGNATURE OF AUDITOR _____
OFFICE LOCATION _____

- Yes ___ No ___ N/A ___ 1. Have all unused and voided accountable documents been returned to the SPM by the team members?
Comments: _____

- Yes ___ No ___ N/A ___ 2. Have document numbers of all lost or destroyed accountable documents been recorded in the SPM's logbook?
Comments: _____

- Yes ___ No ___ N/A ___ 3. Are all samples identified with Sample I.D. Tags?
Comments: _____

- Yes ___ No ___ N/A ___ 4. Are all Sample I.D. Tags completed (e.g., station no., location, date, time, analyses, signatures of samplers, type, preservatives, etc.)?
Comments: _____

- Yes ___ No ___ N/A ___ 5. Are all samples collected listed on a Chain-of-Custody Record?
If yes, describe the type of Chain-of-Custody Record used.
Comments: _____

- Yes ___ No ___ N/A ___ 6. Are the Sample I.D. Tag numbers recorded on the Chain-of-Custody Records?
Comments: _____

- Yes ___ No ___ N/A ___ 7. Does information on Sample I.D. Tags and Chain-of-Custody Records match?
Comments: _____

- Yes ___ No ___ N/A ___ 8. Do the Chain-of-Custody Records indicate the method of sample shipment?
Comments: _____

- Yes ___ No ___ N/A ___ 9. Is a Chain-of-Custody record included with the samples in the shipping container?
Comments: _____

- Yes ___ No ___ N/A ___ 10. Do the sample traffic reports agree with the Sample I.D. Tags?
Comments: _____

Yes ___ No ___ N/A ___ 11. If required, has a copy of a Receipt-For-Samples form been provided to the facility?

Comments: _____

Yes ___ No ___ N/A ___ 12. If required, was the offer of a receipt for samples documented?

Comments: _____

Yes ___ No ___ N/A ___ 13. If used, are blank samples identified?

Comments: _____

Yes ___ No ___ N/A ___ 14. If collected, are duplicate samples identified on Sample I.D. Tags and Chain-of-Custody Records?

Comments: _____

Yes ___ No ___ N/A ___ 15. If used, are spiked samples identified?

Comments: _____

Yes ___ No ___ N/A ___ 16. Are Field Notebooks signed by the individual who checked out the notebook from the SPM?

Comments: _____

- Yes ___ No ___ N/A ___ 17. Are Field Notebooks dated upon receipt from the SPM?
Comments: _____

- Yes ___ No ___ N/A ___ 18. Are Field Notebooks project-specific (by notebook or by page)?
Comments: _____

- Yes ___ No ___ N/A ___ 19. Are Field Notebook entries dated and identified by author?
Comments: _____

- Yes ___ No ___ N/A ___ 20. Is the facility's approval or disapproval to take photographs noted in a Field Notebook?
Comments: _____

- Yes ___ No ___ N/A ___ 21. Are photographs documented in Field Notebooks (e.g., time, date, description of subject, photographer, etc.)?
Comments: _____

- Yes ___ No ___ N/A ___ 22. If a Polaroid camera is used, are photos matched with Field Notebook documentation?
Comments: _____

Yes ___ No ___ N/A ___ 23. Are Sample I.D. Tag numbers recorded in the SPM logbook?
Comments: _____

Yes ___ No ___ N/A ___ 24. Are Quality Control checks documented (i.e., calibration of pH meters, conductivity meters, etc.)?
Comments: _____

Yes ___ No ___ N/A ___ 25. Are amendments to the Project Plan documented (on the Project Plan itself, in a project logbook, elsewhere)?
Comments: _____

FIELD AUDIT CHECKLIST

Debriefing with SPM or
Field Sampling Team Leader

PROJECT NO. _____ DATE OF AUDIT _____
PROJECT MANAGER _____ SIGNATURE OF AUDITOR _____
OFFICE LOCATION _____

Yes ___ No ___ N/A ___ 1. Was a debriefing held with project participants after the audit was completed?

Comments: _____

Yes ___ No ___ N/A ___ 2. Were any recommendations made to project participants during the debriefing?
If yes, briefly describe what recommendations were made.

Comments: _____

DOCUMENT AUDIT CHECKLIST

Closed Files

PROJECT NO. _____ DATE OF AUDIT _____
PROJECT LOCATION _____ SIGNATURE OF AUDITOR _____
OFFICE LOCATION _____

Yes ___ No ___ N/A ___ 1. Have individual files been assembled (field investigation, laboratory, other)?

Comments: _____

Yes ___ No ___ N/A ___ 2. Is each file inventoried?

Comments: _____

Yes ___ No ___ N/A ___ 3. Is a document numbering system used?

Comments: _____

Yes ___ No ___ N/A ___ 4. Has each document been assigned a document control number?

Comments: _____

Yes ___ No ___ N/A ___ 5. Are all documents listed on the inventory accounted for?

Comments: _____

APPENDIX C

DATA REDUCTION

AND

VALIDATION METHODS

APPENDIX C

DATA REDUCTION AND VALIDATION METHODS

Two criteria are used to validate and reduce chemical test data: accuracy and precision. Other considerations such as completeness, representativeness, and comparability depend on accuracy and/or precision and consequently are thought of as subordinate factors (or dependent variables).

ACCURACY

DEFINITION OF RECOVERY

The accuracy of chemical test results is measured by establishing the average recovery. The recovery is determined by splitting a series of samples into two portions, spiking (adding a known quantity of the constituent of interest) one of the portions, and submitting both portions for laboratory analysis as independent samples. Recovery (expressed as a percentage) is computed from equation 1.

$$\text{Recovery} = \frac{\Delta C}{C_s} \times 100 \quad [1]$$

where:

ΔC is the measured concentration increase due to spiking (relative to the unspiked portion)

C_s is the known concentration increase in the spike.

Perfect accuracy would be defined by 100 percent recovery.

STANDARD DEVIATION OF RECOVERY

The uncertainty in the observed recovery is reflected in the calculation of the standard deviation in the recovery and in the correction of the standard deviation to reflect the small number of sample splitting-and-spiking events.

Compute the standard deviation, σ , according to the following formula:

$$\sigma = \sqrt{\frac{\sum (\text{Recovery}_i - \text{Recovery}_{\text{avg}})^2}{n - 1}} \quad [2]$$

where n is the number of split-and-spiked sample pairs.

VALIDATING RECOVERY DATA

To validate recovery data, the individual recoveries (Recovery_i) are compared with the average recovery ($\text{Recovery}_{\text{avg}}$) value to identify individual values that lie outside the range of reasonableness. Chauvenet's criterion is used to identify individual recovery values that lie outside the range of reasonableness.

To use Chauvenet's criterion, the screening variable must be computed for recovery values that are suspected of lying outside the range of reasonableness.

$$\text{Screening Variable} = | (\text{Recovery}_i - \text{Recovery}_{\text{avg}}) / \sigma | \quad [3]$$

The calculated screening variable is then compared to the maximum allowable value (Table C-1) for the appropriate number of recovery determinations. The suspect recovery

Table C-1
 CHAUVENET'S CRITERION
 FOR REJECTING A SUSPECTED VALUE^a

| Number of Samples n | Maximum Allowable Values for (Recovery _i - Recovery _{avg}) / σ ^b |
|------------------------|---|
| 5 | 2.015 |
| 6 | 2.111 |
| 7 | 2.164 |
| 8 | 2.195 |
| 9 | 2.214 |
| 10 | 2.228 |
| 11 | 2.279 |
| 12 | 2.318 |
| 13 | 2.348 |
| 14 | 2.373 |
| 15 | 2.393 |
| 16 | 2.409 |
| 17 | 2.424 |
| 18 | 2.435 |
| 19 | 2.445 |
| 20 | 2.454 |
| 21 | 2.462 |
| 22 | 2.469 |
| 23 | 2.475 |
| 24 | 2.480 |
| 25 | 2.485 |
| 26 | 2.502 |
| 27 | 2.517 |
| 28 | 2.530 |
| 29 | 2.543 |
| 30 | 2.555 |
| 40 | 2.634 |

^aBased on "t" distribution rather than the traditional "normal" distribution.

^bIndividual Recovery = Recovery_i

Average Recovery = Recovery_{avg}

DE/LOWRY2/015

value is set aside (set-aside values are called "outliers") if the calculated screening variable equals or exceeds the maximum allowable value.

If outliers are identified using Chauvenet's criterion, a new average recovery and a new standard deviation are recalculated using the remaining "good" values, and Chauvenet's criterion is reapplied. This procedure is repeated until all surviving recovery values pass Chauvenet's criterion. (Usually one application and one recalculation are enough.) The final average recovery and final standard deviation are calculated from the "surviving" recovery values. The final average recovery value is used to eliminate any bias from the laboratory data.

RANGE OF UNCERTAINTY IN THE RECOVERY

The range of uncertainty, R , in the recovery is computed from:

$$\pm R = \pm t\sigma / n \quad [4]$$

where:

R is the range of uncertainty expressed as percent

t is the value of the t distribution for the selected confidence level (usually the 90 percent confidence level) and $(n - 1)$ degrees of freedom (Table C-2)

n is the number of samples that have been split

σ is the standard deviation.

Table C-2
DISTRIBUTION OF t

| Number of Sample | Degrees of Freedom | "Complementary" Probability (as percent) | | | | | | |
|------------------------|--------------------------|--|-------|-------|-------|--------|--------|--------|
| | | 50 | 70 | 80 | 90 | 95 | 98 | 99 |
| 2 | 1 | 1.000 | 1.963 | 3.078 | 6.314 | 12.706 | 31.821 | 63.657 |
| 3 | 2 | .816 | 1.386 | 1.886 | 2.920 | 4.303 | 6.965 | 9.925 |
| 4 | 3 | .765 | 1.250 | 1.638 | 2.353 | 3.182 | 4.541 | 5.841 |
| 5 | 4 | .741 | 1.190 | 1.533 | 2.132 | 2.776 | 3.747 | 4.604 |
| 6 | 5 | .727 | 1.156 | 1.476 | 2.015 | 2.571 | 3.365 | 4.032 |
| 7 | 6 | .718 | 1.134 | 1.440 | 1.943 | 2.447 | 3.143 | 3.707 |
| 8 | 7 | .711 | 1.119 | 1.415 | 1.895 | 2.365 | 2.998 | 3.499 |
| 9 | 8 | .706 | 1.108 | 1.397 | 1.860 | 2.306 | 2.896 | 3.355 |
| 10 | 9 | .703 | 1.100 | 1.383 | 1.833 | 2.262 | 2.821 | 3.250 |
| 11 | 10 | .700 | 1.093 | 1.372 | 1.812 | 2.228 | 2.764 | 3.169 |
| 12 | 11 | .697 | 1.088 | 1.363 | 1.796 | 2.201 | 2.718 | 3.106 |
| 13 | 12 | .695 | 1.083 | 1.356 | 1.782 | 2.179 | 2.681 | 3.055 |
| 14 | 13 | .694 | 1.079 | 1.350 | 1.771 | 2.160 | 2.650 | 3.012 |
| 15 | 14 | .692 | 1.076 | 1.345 | 1.761 | 2.145 | 2.624 | 2.977 |
| 16 | 15 | .691 | 1.074 | 1.341 | 1.753 | 2.131 | 2.602 | 2.947 |
| 17 | 16 | .690 | 1.071 | 1.337 | 1.746 | 2.120 | 2.583 | 2.921 |
| 18 | 17 | .689 | 1.069 | 1.333 | 1.740 | 2.110 | 2.567 | 2.898 |
| 19 | 18 | .688 | 1.067 | 1.330 | 1.734 | 2.101 | 2.552 | 2.878 |
| 20 | 19 | .688 | 1.066 | 1.328 | 1.729 | 2.093 | 2.539 | 2.861 |
| 21 | 20 | .687 | 1.064 | 1.325 | 1.725 | 2.086 | 2.528 | 2.845 |
| 22 | 21 | .686 | 1.063 | 1.323 | 1.721 | 2.080 | 2.518 | 2.831 |
| 23 | 22 | .686 | 1.061 | 1.321 | 1.717 | 2.074 | 2.508 | 2.819 |
| 24 | 23 | .685 | 1.060 | 1.319 | 1.714 | 2.069 | 2.500 | 2.807 |
| 25 | 24 | .685 | 1.059 | 1.318 | 1.711 | 2.064 | 2.492 | 2.797 |
| 26 | 25 | .684 | 1.058 | 1.316 | 1.708 | 2.060 | 2.485 | 2.787 |
| 27 | 26 | .684 | 1.058 | 1.315 | 1.706 | 2.056 | 2.479 | 2.779 |
| 28 | 27 | .684 | 1.057 | 1.314 | 1.703 | 2.052 | 2.473 | 2.771 |
| 29 | 28 | .683 | 1.056 | 1.313 | 1.701 | 2.048 | 2.467 | 2.763 |
| 30 | 29 | .683 | 1.055 | 1.311 | 1.699 | 2.045 | 2.462 | 2.756 |
| 31 | 30 | .683 | 1.055 | 1.310 | 1.697 | 2.042 | 2.457 | 2.750 |
| 41 | 40 | .681 | 1.050 | 1.303 | 1.684 | 2.021 | 2.423 | 2.704 |
| 61 | 60 | .679 | 1.046 | 1.296 | 1.671 | 2.000 | 2.390 | 2.660 |
| 121 | 120 | .677 | 1.041 | 1.289 | 1.658 | 1.980 | 2.358 | 2.617 |
| | ∞ | .674 | 1.036 | 1.282 | 1.645 | 1.960 | 2.326 | 2.576 |

DE/LCWRY2/016

The range of uncertainty, R, is used in conjunction with the average recovery to determine if bias adjustments are required.

CORRECTING FOR INACCURACY

Together, the final average recovery value and the corresponding range of uncertainty constitute the statement of accuracy for a particular sampling program. If 100 percent recovery lies outside the range of the final average recovery value \pm range of uncertainty, then all test data are corrected to eliminate bias. Test data are corrected by multiplying by 100, then dividing by the final average recovery value (expressed as a percent). If 100 percent lies within the final average recovery value \pm the range of uncertainty, then no bias correction is required.

COMPLETENESS OF ACCURACY DATA

The completeness of accuracy data is that percentage of the total number of spiked-unspiked pairs that remain after outliers are identified and set aside with Chauvenet's criterion.

PRECISION

The precision of the chemical test results is reflected in the amount of scatter that would be observed in repetitious measurements of a component in a single sample. In most sampling programs, scatter is attributable either to chemical analysis or to errors committed during sampling. Most of the time, sampling error will be small, and the principal source of scatter will be laboratory analysis.

COMPARISON OF SAMPLING AND LABORATORY SCATTER

The relative contributions of analytical error and of sampling error can be established by comparing the scatter in independent sample pairs (from the same location) with the scatter in the splits.

For each independent pair of samples (from the same location), compute the Industrial Statistic:

$$I_{\text{pair}} = \frac{2 |A - B|}{A + B} \quad [5]$$

where:

A and B are the independent test results of a sample pair that should yield the same test result if the precision were perfect

I is the Industrial Statistic for the sample pair.

Next, compute the standard deviation for the Industrial Statistics of the paired samples.

$$\sigma_{I_{\text{pair}}} = \frac{\sum_{i=1}^n (I_i - \bar{I})^2}{n - 1} \quad [6]$$

where:

I_i represents the individual industrial statistics for the paired samples

\bar{I} is the average value for the industrial statistic

n is the number of sample pairs that were tested.

The next step is to calculate the individual industrial statistic for each set of split samples.

$$J_{\text{split}} = \frac{2 |C - D|}{C + D} \quad [7]$$

where:

C and D are independent test results of each member of a split sample

The standard deviation for the split samples is the calculated:

$$\sigma_{J_{\text{split}}} = \frac{\sum_{i=1}^m (J_i - \bar{J})^2}{m - 1} \quad [8]$$

where:

J_i and \bar{J} are analogous with I_i and \bar{I}

m is the number of samples that were split for independent duplicate analysis.

The "t" test is used to test for significant difference between \bar{I} and \bar{J} . To use the "t" test, the value "t" must first be computed from:

$$t = \frac{\bar{I} - \bar{J}}{\sqrt{\frac{1}{m} + \frac{1}{n} \frac{\sigma_{\text{pair}}^2 (n-1) + \sigma_{\text{split}}^2 (m-1)}{m + n - 2}}} \quad [9]$$

The quantity $(m + n - 2)$ is referred to as the number of degrees of freedom. Compare the value of "t" from [9] with the value of "t" in Table C-2 for 90 percent probability and $(m + n - 2)$ degrees of freedom.

If the value in Table C-2 is smaller than the calculated value for "t," then there is a significant difference between the paired and the split samples, and the Project Manager should investigate sampling practices, storage, shipping and handling procedures, and other aspects of the field investigation. No further statistical analysis is needed until the matter is re-examined (or the site is further investigated).

If the value in Table C-2 is larger than the calculated value for "t," then there is no significant difference between paired samples and split portions, and statistical evaluation of the test data should continue.

VALIDATING DATA

The next step in validating the test data is to calculate the individual relative standard deviations for the sampling locations where both paired samples were collected and at least one of the pairs was split into two portions. The individual relative standard deviations are computed from:

$$\sigma_{\text{set}_i} = \frac{\sum_{j=1}^{p_i} (w_j - 1)^2}{p_i - 1} \quad [10]$$

where:

σ_{set_i} represents the relative standard deviations for each set of samples, including both the paired samples and the split fractions in the set

w_j represents the normalized values of the individual data points in each set, calculated from $w_j = x_j / \bar{x}_i$ (x_j is the actual reported value and \bar{x}_i is the average value for the pair-split data points in that set)

p_i represents the numbers of data points in each data set ($p_i = 3$ if only one sample of a pair is split and $p_i = 4$ if both samples of a pair are split and none of the split portions are spiked)

The individual relative standard deviations, $\sigma_{\text{set } i}$'s, are

tabulated in ascending order of their relative values, the largest value being listed last. The F-ratio test is then used to determine whether the largest $\sigma_{\text{set } i}$ is signifi-

cantly larger than the collective relative standard deviation computed from the remaining smaller $\sigma_{\text{set } i}$ values. If

so, then the data set from which the largest $\sigma_{\text{set } i}$ was

computed is set aside as having a range outside the expected limits, and the test is reapplied to determine if the next largest value is significantly larger than the recomputed collective relative standard deviation.

To perform the F-ratio test, the collective relative standard deviation is computed using all but the largest $\sigma_{\text{set } i}$

values:

$$\sigma_{\text{collective}}^2 = \frac{\sigma_{\text{set}_1}^2 (p_1-1) + \sigma_{\text{set}_2}^2 (p_2-1) + \dots + \sigma_{\text{set}_k}^2 (p_k-1)}{(p_1-1) + (p_2-1) + \dots + (p_k-1)} \quad [11]$$

where:

all $\sigma_{\text{set } i}$ values are used except the largest.

The value of F is calculated as the square of the ratio of the largest $\sigma_{\text{set } i}$ to $\sigma_{\text{collective}}$.

$$F_{\text{calc}} = \frac{(\sigma_{\text{set}_i})^2}{(\sigma_{\text{collective}})^2} \quad [12]$$

The value of F_{calc} will always be greater than one.

The number of degrees of freedom for the largest individual relative standard deviation $\sigma_{\text{set } i}$ is $(p_i - 1)$. The numerical value for $p_i - 1$ will usually be 2, but sometimes will be 3 (when both samples of a pair are split but not spiked). The number of degrees of freedom for $\sigma_{\text{collective}}$ is the same as the denominator in equation [11], namely,

$(p_1-1)+(p_2-1)+\dots+(p_k-1)$, excluding the (p_i-1) corresponding to the largest individual $\sigma_{\text{set } i}$.

Locate in Table C-3 the number of degrees of freedom for the largest $\sigma_{\text{set } i}$ by reading across the top row, labeled

"Degrees of Freedom for Largest $\sigma_{\text{set } i}$." Then read down the

column beneath the degrees of freedom corresponding to $\sigma_{\text{set } i}$

and locate the value of F corresponding to the degrees of freedom of the smallest variance, $\sigma_{\text{collective}}$. If F_{calc} is

greater than $F_{\text{tabulated}}$, then the data points used in the

computation of $\sigma_{\text{set } i}$ should be set aside because the

scatter in the chemical data is outside the range expected by chance alone.

If the data set corresponding to the largest $\sigma_{\text{set } i}$ is

set aside, then a new $\sigma_{\text{collective}}$ should be calculated

omitting $\sigma_{\text{set } i}$ values for the set aside data and for the

next largest relative standard deviation, $\sigma_{\text{set } j}$. The

F-ratio test is rerun to determine if $\sigma_{\text{set } j}$ should be

Table C-3
DISTRIBUTION OF F AT 95 PERCENT CONFIDENCE LEVEL

| Degrees of Freedom for σ^2 collective | Degrees of Freedom for Largest σ^2 set i | | | | | |
|---|---|-------|-------|-------|-------|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | 161.4 | 199.5 | 215.7 | 224.6 | 230.2 | 234.0 |
| 2 | 18.51 | 19.00 | 19.16 | 19.25 | 19.30 | 19.33 |
| 3 | 10.13 | 9.55 | 9.28 | 9.12 | 9.01 | 8.94 |
| 4 | 7.71 | 6.94 | 6.59 | 6.39 | 6.26 | 6.16 |
| 5 | 6.61 | 5.79 | 5.41 | 5.19 | 5.05 | 4.95 |
| 6 | 5.99 | 5.14 | 4.76 | 4.53 | 4.39 | 4.28 |
| 7 | 5.59 | 4.74 | 4.35 | 4.12 | 3.97 | 3.87 |
| 8 | 5.32 | 4.46 | 4.07 | 3.84 | 3.69 | 3.58 |
| 9 | 5.12 | 4.26 | 3.86 | 3.63 | 3.48 | 3.37 |
| 10 | 4.96 | 4.10 | 3.71 | 3.48 | 3.33 | 3.22 |
| 11 | 4.84 | 3.98 | 3.59 | 3.36 | 3.20 | 3.09 |
| 12 | 4.75 | 3.89 | 3.49 | 3.26 | 3.11 | 3.00 |
| 13 | 4.67 | 3.81 | 3.41 | 3.18 | 3.03 | 2.92 |
| 14 | 4.60 | 3.74 | 3.34 | 3.11 | 2.96 | 2.85 |
| 15 | 4.54 | 3.68 | 3.29 | 3.06 | 2.90 | 2.79 |
| 16 | 4.49 | 3.63 | 3.24 | 3.01 | 2.85 | 2.74 |
| 17 | 4.45 | 3.59 | 3.20 | 2.96 | 2.81 | 2.70 |
| 18 | 4.41 | 3.55 | 3.16 | 2.93 | 2.77 | 2.66 |
| 19 | 4.38 | 3.52 | 3.13 | 2.90 | 2.74 | 2.63 |
| 20 | 4.35 | 3.49 | 3.10 | 2.87 | 2.71 | 2.60 |
| 21 | 4.32 | 3.47 | 3.07 | 2.84 | 2.68 | 2.57 |
| 22 | 4.30 | 3.44 | 3.05 | 2.82 | 2.66 | 2.55 |
| 23 | 4.28 | 3.42 | 3.03 | 2.80 | 2.64 | 2.53 |
| 24 | 4.26 | 3.40 | 3.01 | 2.78 | 2.62 | 2.51 |
| 25 | 4.24 | 3.39 | 2.99 | 2.76 | 2.60 | 2.49 |
| 26 | 4.23 | 3.37 | 2.98 | 2.74 | 2.59 | 2.47 |
| 27 | 4.21 | 3.35 | 2.96 | 2.73 | 2.57 | 2.46 |
| 28 | 4.20 | 3.34 | 2.95 | 2.71 | 2.56 | 2.45 |
| 29 | 4.18 | 3.33 | 2.93 | 2.70 | 2.55 | 2.43 |
| 30 | 4.17 | 3.32 | 2.92 | 2.69 | 2.53 | 2.42 |
| 40 | 4.08 | 3.23 | 2.84 | 2.61 | 2.45 | 2.34 |
| 60 | 4.00 | 3.15 | 2.76 | 2.53 | 2.37 | 2.25 |
| 120 | 3.92 | 3.07 | 2.68 | 2.45 | 2.29 | 2.17 |
| ∞ | 3.84 | 3.00 | 2.60 | 2.37 | 2.21 | 2.10 |

DE/LCWRY2/017

set aside because of excessive scatter. Data sets are successively set aside until the largest remaining $\sigma_{\text{set } i}$ passes the F-ratio test.

A value of $\sigma_{\text{set } i}$ passes the F-ratio test if F_{calc} is less than $F_{\text{tabulated}}$.

OVERALL STANDARD DEVIATION

The $\sigma_{\text{set } i}$ values that are retained after screening for excessive scatter are all used to compute the overall relative standard deviation from the relationship:

$$\sigma_{\text{overall}} = \frac{\sigma_{\text{set}_1}^2 (p_1 - 1) + \sigma_{\text{set}_2}^2 (p_2 - 1) + \dots + \sigma_{\text{set}_q}^2 (p_q - 1)}{\sum p_i - q - 1} \quad [13]$$

where:

$\sum p_i$ gives the total number of individual chemical analysis (excluding those set aside)

q is the number of pair/split data sets (excluding those set aside)

$\sigma_{\text{set } i}$ retains the meaning given in equation 11.

DATA PRECISION

The maximum expected uncertainty for any individual chemical test result is:

$$x \pm x t_{\sigma_{\text{overall}}} / \sum p_i - q \quad [14]$$

where:

$\sum p_i$ and q have the meaning given in equation 13

x is the reported chemical test result

t is the value of the "t" distribution for $(\sum p_i - q)$ degrees of freedom in Table C-2 for the 90 percent (complementary) probability level

COMPLETENESS OF PRECISION DATA

The completeness of the precision data is interpreted as the percentage of unspiked data that remain after outliers are identified and set aside with the F-ratio test.

DE/LOWRY2/014

APPENDIX D

AUDIT PROGRAM

AUDIT PROCEDURES

FIELD ACTIVITIES

The QAM may schedule audits of field activities at various times to evaluate the execution of sample identification, sample control, chain-of-custody procedures, field documentation, and sampling operations. The evaluation is based on the extent to which the applicable SOPs are being followed.

The person conducting the audit is normally a senior technical reviewer who is familiar with the technical and procedural requirements of field sampling and with the applicable project documents (i.e., QAPP, SOP, Field Operations Plan, etc.). The auditor keeps a record of his evaluation using field notes and checklists (see pages D-6 through D-23). Following the audit, he reviews its preliminary results with the person in charge of the sampling. The auditor also prepares an audit report containing the results of his evaluation and recommendations for any necessary corrective actions.

Audits are scheduled with the SPM and the person in charge of the field sampling.

Sample Identification Tags

The auditor examines a selected number of Sample Identification Tags for completeness and accuracy. He determines if the station number and location are identified; the date and time collected are indicated; the type of sample and analysis are specified; the preservative, if used, is identified; and

the samplers' signatures appear on the tag. The tag numbers will be checked to ensure that they are the ones issued to the project. The auditor also determines if the station location accurately identifies where the sample was actually taken and if the sampling methods used were as directed by the SPM.

Chain-of-Custody Records

The auditor selects a predetermined number of the Chain-of-Custody Records to be audited in the field. The records must be reviewed to determine if the station number, station description, date, and time correspond to the Sample Identification Tag; if the parameters to be analyzed have been appropriately identified; and if all custody transfers have been documented and the date and time of transfer recorded.

The auditor also determines if samples are kept in custody at all times and are locked up to prevent tampering. Sampling equipment is checked for security and to detect any tampering.

Receipt-for-Samples Form

The auditor checks to make sure that a Receipt-for-Samples form is given to the owner, operator, or agent-in-charge of a facility or site whenever splits are provided for them, even if the offer for split samples is declined. The auditors also check to make sure that the forms are properly completed and that signatures are obtained. If signatures aren't obtained, he checks the "Remarks" section of the Chain-of-Custody Record for the transaction to see if a signature was requested and declined.

Viar Forms

The firm Viar and Company of Alexandria, Virginia, has been awarded a contract by EPA to manage the shipment of samples from hazardous waste site investigations and to allocate workloads to the participating contractor laboratories. It executes its contract from the SMO. Organic, Inorganic, and high-hazard Traffic Reports and Special Analytical Services Request Forms prepared by field investigation teams for samples shipped to contractor laboratories also are subject to audit. The auditor ensures that the information recorded on the forms is correct and that it coincides with the information on the Sample Identification Tags and on the Chain-of-Custody Record.

Field Notebooks

Field Notebooks are reviewed during the field investigation audit to see that each is signed and all entries are dated. During field investigations, notebooks are either in the possession of individuals or, for large sampling projects, are kept at each sampling station or location. The project number, EPA site number, date of receipt, and the name of the person receiving the book are usually recorded on the cover. For notebooks kept at each station, the project number and station number are usually recorded on the cover and on each page. All in-situ measurements and field observations are recorded in the notebook with all pertinent information necessary to explain and reconstruct sampling operations. Each page is dated and signed by all individuals making entries on that page. The SPM and the field team on duty are responsible for ensuring that notebooks are present during all monitoring activities and are stored safely to avoid possible tampering. Any lost, damaged, or voided notebooks are reported to the SPM.

Notebook entries must be legible, written in ink, and contain accurate and inclusive documentation of project activities. Because the notebook forms the basis for reports written later, it must contain only facts and observations. Language should be objective, factual, and free of personal feelings or other terminology that might prove inappropriate. Entries made by individuals other than the person to whom the notebook was assigned must be dated and signed by the individual making the entry.

Photographs may be taken for evidentiary purposes and these must also be controlled. The auditor reviews the Field Notebook to determine if the photographs are properly documented. When movies, slides, or photographs are taken showing sampling sites or providing other documentation, they are numbered to correspond to the notebook entries. The name of the photographer, date, time, site location, and site description are entered sequentially in the notebook as photos are taken.

The SPM's logbook will document the transfer of notebooks to the individuals who have been designated to perform specific tasks on the field investigation. All pertinent information should be recorded in these logbooks from the time each individual is assigned to the project until the project is completed.

The auditor will review Field Notebooks for their adherence to these procedures.

Sampling Operations

The auditor reviews sampling operations to determine if they are performed as stated in the project plan or as directed by the SPM. The proper number of samples should be collected

at the assigned locations. The auditor checks to determine that the samples are in proper containers and are properly preserved.

He also determines if the required field measurements and quality assurance checks are being performed and documented as directed.

DOCUMENT CONTROL

Once a project has been completed, the individual files must be assembled, organized, and securely stored or returned to EPA. The QAM may schedule audits of project files.

The document control audit consists of checking each document submitted for accountability. All documents used for field investigations are checked against the list of field documents issued to the SPM or his designated person. Written explanations must be present for any documents unaccounted for. Documents other than those issued are reviewed to ensure that they all appear on an inventory and that all documents listed on the inventory are accounted for. The auditor checks the documents for an appropriate numbering system.

The documents are examined to determine that all necessary items such as signatures, dates, and project codes are included.

The auditor examines any classified documents and determine if they are handled and stored in the proper manner.

FIELD AUDIT CHECKLIST

Briefing with SPM

PROJECT NO. _____ DATE OF AUDIT _____
PROJECT MANAGER _____ SIGNATURE OF AUDITOR _____
OFFICE LOCATION _____

Yes ___ No ___ N/A ___ 1. Was a QA Project Plan and a Site Health and Safety Plan prepared? If yes, what items are addressed in the plan?

Comments: _____

Yes ___ No ___ N/A ___ 2. Was a briefing held with project participants?

Comments: _____

Yes ___ No ___ N/A ___ 3. Were additional instructions given to project participants (i.e., changes in project plan)?

Comments: _____

Yes ___ No ___ N/A ___ 4. Is there a written list of sampling locations and descriptions?

Comments: _____

Yes ___ No ___ N/A ___ 5. Is there a map of sampling locations?

Comments: _____

- Yes ___ No ___ N/A ___ 6. Does the sampling team follow a system of accountable documents?
If yes, what documents are accountable?
Comments: _____

- Yes ___ No ___ N/A ___ 7. Is there a list of accountable field documents checked out to the SPM or designated person?
If yes, who checked them out?
Comments: _____

- Yes ___ No ___ N/A ___ 8. Is the transfer of field documents (Sample I.D. Tags, Chain-of-Custody Records, logbooks, etc.) from the SPM to the field participants documented in a logbook?
Comments: _____

